United States Environmental Protection Agency
Office of Environmental Information Washington, DC 20460
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EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT - SECTION 313:

Draft Guidance for Reporting Releases and Other Waste Management Activities of Toxic Chemicals: Lead and Lead Compounds

EXECUTIVE SUMMARY

The Toxics Release Inventory (TRI) Program was established by Congress under Section 313 of the *Emergency Planning and Community Right-to-Know Act of 1986* (EPCRA). It requires certain facilities in covered industry sectors to file reports of their environmental releases and other waste management activities of chemicals listed on the EPCRA section 313 list of toxic chemicals if they manufacture, process, or otherwise use more than established threshold quantities of these chemicals. The releases and other waste management activities of a listed chemical are filed by completing an EPCRA section 313 release report (Form R) and submitting it to the U.S. Environmental Protection Agency, state and tribal governments.

Lead and lead compounds are on the EPCRA section 313 list of toxic chemicals. On January 17, 2001, EPA published a rule that lowered the 25,000 lb and 10,000 lb reporting thresholds for lead and lead compounds to 100 pounds. Provided SIC code and employee criteria are met, facilities that manufacture, process or otherwise use 100 pounds or more of lead or any lead compound(s) must now report to EPA and state/tribal governments their releases and other waste management activities. The lower reporting thresholds apply to lead and all lead compounds, except for lead contained in stainless steel, brass, and bronze alloys. The new requirements apply to annual Form R reports for the calendar year 2001 and beyond. The reason for the lower reporting threshold is that lead and lead compounds are persistent bioaccumulative and toxic (PBT) chemicals. PBT chemicals are of concern because not only are they toxic, but they also remain in the environment for long periods of time, are not readily destroyed, and build up or accumulate in organisms or body tissue. The rule is part of the Agency's effort to expand the public's right to know about release and other waste management activities of toxic chemicals – particularly PBT chemicals – in their communities. As a result of this rulemaking and reduced threshold, EPA anticipates many more release reports (Form Rs) to be filed with EPA. Many of these additional reports will be filed by those entities that previously did not file release reports for lead and lead compounds because they did not meet the 25,000 lb and 10,000 lb thresholds.

EPA has developed this guidance document to assist regulated entities, particularly those that are not familiar with completing and submitting EPCRA section 313 release reports, in complying with this new regulation. This guidance document provides clear, easy to follow guidance on: the specific details of this new regulation; what facilities must file release reports for lead and lead compounds; what forms of lead and lead compounds are not affected by the new reporting requirements; and methods to estimate releases of lead and lead compounds into the environment following manufacture, processing, use, or waste management activities of lead and lead compounds.

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DISCLAIMER

This guidance document is intended to assist industry with complying with EPCRA section 313 reporting requirements for lead and lead compounds. In addition to providing an overview of aspects of the statutory and regulatory requirements of the EPCRA section 313 program, this document also provides recommendations and emission factors to assist industry with EPCRA reporting. These recommendations do not supersede any statutory or regulatory requirements, are subject to change, and are not independently binding on either EPA or covered facilities. Additionally, if a conflict exists between this guidance and the statutory or regulatory requirements, the conflict must be resolved in favor of the statute or regulation. Although EPA encourages industry to consider these recommendations and emission factors, in reviewing this document, industry should be aware that these recommendations and emission factors were developed to address common circumstances at typical facilities. The circumstances at a specific facility may significantly differ from those contemplated in the development of this document. Thus individual facilities may find that the recommendations and emission factors provided in this document are inapplicable to their processes or circumstances, and that alternative approaches or information are more accurate and/or more appropriate for meeting the statutory and regulatory requirements of EPCRA section 313. To that end, industry should use facility-specific information and process knowledge, where available, to meet the requirements of EPCRA section 313. Facilities are encouraged to contact the Agency with any additional or clarifying questions about the recommendations and emission factors in this document, or if the facility believes that EPA has incorrectly characterized a particular process or recommendation. Additional guidance documents, including industry specific and chemical specific guidance documents, are also available at the EPA TRI website: <http://www.epa.gov/tri>.

SECTION 1.0 INTRODUCTION

Section 1.1 Background

The Toxics Release Inventory (TRI) Program was established by Congress under section 313 of the *Emergency Planning and Community Right-to-Know Act of 1986* (EPCRA) to increase the public's knowledge of, and access to, information on the release and other waste management activities of toxic chemicals in their communities. Section 313 of EPCRA empowers the public with the right-to-know of releases of toxic chemicals in their communities by requiring those facilities that manufacture, process, or otherwise use such chemicals in quantities that exceed established thresholds to report annually to the U.S. Environmental Protection Agency (EPA), and state and tribal governments their environmental releases and other waste management activities of these substances. EPCRA mandates that EPA establish and maintain a publicly available database consisting of the information reported under section 313. This database, known as the Toxics Release Inventory (TRI), can be easily accessed through the following sources:

- EPA's Internet site, www.epa.gov/tri;
- Envirofacts Warehouse Internet site; www.epa.gov/enviro/html/tris/tris_overview.html; and
- EPA's annual TRI data release materials (summary information).

The releases and other waste management activities of a listed chemical are filed by completing an EPCRA section 313 release report (Form R or Form A) and submitting it to the U.S. EPA and state and tribal governments. These forms must be submitted on or before July 1, for activities in the previous calendar year (42 U.S.C. Š 11023(a)). The owner/operator of the facility on July 1 is primarily responsible for the report, even if the owner/operator did not own the facility during the reporting year (40 CFR 372.5; see also Reference 1 in Section 6.0 - EPA's 1998 Revised EPCRA Section 313 Questions and Answers, Question Number 47). A facility is required to file EPCRA section 313 reports if it meets all three of the following criteria: 1) it is included in certain Standard Industrial Classification

(SIC) codes; 2) it has 10 or more full-time employee equivalents (i.e., the equivalent of 20,000 hours per year); and 3) it manufactures (includes imports), processes, or otherwise uses any of the toxic chemicals listed on the EPCRA section 313 list in amounts greater than specified threshold quantities. These three criteria alone, not the quantities released or otherwise managed as waste, determine whether a facility must complete and file an EPCRA section 313 report. A facility that meets these three criteria is still required to complete and file an EPCRA section 313 report even if that facility has release and other waste management quantities of zero of EPCRA section 313 chemicals or chemical categories.

Lead and lead compounds are on the EPCRA section 313 list of toxic chemicals. On January 17, 2001 EPA published a rule[1] that lowered the 25,000 lb and 10,000 lb reporting thresholds for lead and lead compounds to 100 pounds. The reason for the lower reporting thresholds is that EPA determined that lead and lead compounds are persistent bioaccumulative and toxic (PBT) chemicals. PBT chemicals are of concern because not only are they toxic, but they also remain in the environment for long periods of time, are not readily destroyed, and build up or accumulate in organisms or body tissue. The rule is part of the Agency's effort to expand the public's right to know about release and other waste management activities of toxic chemicals – particularly PBT chemicals – in their communities. Hence, provided SIC code and employee criteria are met, facilities that manufacture, process or otherwise use 100 pounds or more of lead or any lead compound(s) must now report annually to EPA and state/tribal governments their releases and other waste management activities. The lower reporting thresholds apply to lead and all lead compounds, except for lead contained in stainless steel, brass, and bronze alloys.

Up until promulgation of the new lead rule, only those facilities that manufactured or processed 25,000 lbs (or otherwise used 10,000 lbs) or more of lead or lead compounds were required to report. The primary difference between the new rule and the previous requirements is that the new rule requires any affected facility that manufactures, processes, or otherwise uses 100 lbs or more of lead or lead compound(s) to report. Under the new rule additional data pertaining to releases of lead into the

[1] Lead and Lead Compounds; Lowering of Reporting Thresholds; Community Right-to-Know Toxic Chemical Release Reporting; Final Rule. Federal Register, 66, 4499-4547 (January 17, 2001); Reference 2 in Section 6.0.

environment will be captured. The new TRI lead rule does not in any way prevent or restrict any facility from manufacturing, processing, or otherwise using lead or lead compounds, or from releasing lead into the environment.

As a result of the 100 lb threshold, EPA anticipates many more EPCRA section 313 release reports (Form Rs) to be filed with EPA. Many of these additional reports will be filed by those entities that previously did not file release reports for lead and lead compounds because they did not meet the 25,000 lb and 10,000 lb thresholds. The new requirements apply to annual Form R reports for the calendar year 2001 and beyond. That is, by July 1, 2002 those covered facilities that manufacture, process, or otherwise use lead or lead compounds must file their release reports under the 100 lb threshold for manufacturing, processing, or otherwise use activities that took place on January 1, 2001 through December 31, 2001 (66 FR 4505). Subsequent reports under the 100 lb threshold must be filed annually.

EPA has developed this guidance document to assist regulated entities, particularly those that are not familiar with completing and submitting EPCRA section 313 release reports, in complying with this new regulation. This guidance document provides clear, easy to follow guidance on: the specific details of this new regulation; what facilities must file release reports for lead and lead compounds; what forms of lead and lead compounds are not affected by the new reporting requirements; and methods to estimate releases of lead and lead compounds into the environment following manufacture, processing, otherwise use, or waste managements activities of lead and lead compounds. This document explains the EPCRA section 313 reporting requirements, and provides guidance on how to estimate annual releases and other waste management quantities of lead and lead compounds to the environment from certain industries and industrial activities. Because each facility is unique, the recommendations presented may have to be adjusted to the specific nature of operations at your facility or industrial activity.

The primary objectives of this guidance document are to:

- Provide explanation and assistance on EPCRA section 313 reporting requirements for lead and the lead compounds category;
- Promote consistency in the method of estimating annual releases and other waste management quantities of lead and lead compounds for certain industries and industrial classes; and
- Reduce the level of effort expended by those facilities that prepare an EPCRA section 313 report for lead and/or the lead compounds category.

Section 1.2 Who Must Report?

To understand the following discussion one must first understand how EPCRA defines a facility. The term "facility" is defined as, "all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, which is controlled by, or which is under common control with such person)." (EPCRA Section 328(4)). A facility may contain more than one "establishment" (40 CFR 372.3). An "establishment" is defined as, "an economic unit, generally at a single physical location, where business is conducted or where services or industrial operations are performed" (40 CFR 372.3).

EPA recognizes that for business reasons it may be easier and more appropriate for establishments at one facility to report separately. However, the combined quantities of EPCRA section 313 chemicals and chemical categories manufactured, processed, or otherwise used in all establishments making up that facility must be considered for threshold determinations (40 CFR 372.30 (c)). Also, the combined release and other waste management activities reported singly for each establishment must total those for the facility as a whole (40 CFR 372.30(c)).

Note that if a facility is comprised of more than one establishment, once an activity threshold is met by the facility, provided that the facility meets the SIC code and employee threshold criteria, release

and other waste management activities from all establishments at the facility must be reported (40 CFR 372.30(c)).

A facility is subject to the provisions of EPCRA section 313, if it meets all three of the following criteria:

- It is included in the following Standard Industrial Classification (SIC) Codes: Metal Mining, SIC Code 10 (except SIC codes 1011, 1081, and 1094); Coal Mining, SIC Code 12 (except SIC code 1241); Manufacturing SIC Codes 20 through 39; Electric Utilities, SIC Codes 4911, 4931, or 4939 (each limited to facilities that combust coal and/or oil for the purpose of generating power for distribution in commerce); Commercial Hazardous Waste Treatment, SIC Code 4953 (limited to facilities regulated under the Resource Conservation and Recovery Act, subtitle C, 42 U.S.C. section 6921 et seq.); Chemicals and Allied Products-Wholesale, SIC Code 5169; Petroleum Bulk Terminals and Plants, SIC Code 5171; and, Solvent Recovery Services, SIC Code 7389 (limited to facilities primarily engaged in solvent recovery services on a contract or fee basis); and

- It has 10 or more full-time employees (or the equivalent of 20,000 hours per year); and

- It manufactures (includes imports), processes, or otherwise uses any of the toxic chemicals listed on the EPCRA section 313 list in amounts greater than the threshold quantities established in 40 CFR 372.25, 372.28. See Section 1.3 for a description of reporting thresholds.

These three criteria alone, not the quantity released and otherwise managed as waste, determine whether a facility must prepare an EPCRA section 313 report. A facility that meets these three criteria is still required to prepare an EPCRA section 313 report even if that facility has zero release and other waste management quantities of EPCRA section 313 chemicals or chemical categories.

In addition, pursuant to Executive Order 13148 entitled "Greening the Government Through Leadership in Environmental Management," federal facilities are required to comply with the reporting requirements of EPCRA section 313. This requirement is mandated regardless of the federal facility's SIC code.

Section 1.3 What Are the Reporting Thresholds?

Thresholds are specified amounts of listed toxic chemicals manufactured, processed, or otherwise used during the calendar year that trigger reporting requirements. EPCRA section 313 establishes default reporting thresholds (25,000 pounds for manufacturing and processing and 10,000 pounds for otherwise using; 42 U.S.C. Š 11023(f)(1)), but authorizes EPA to establish different thresholds for particular chemicals, classes of chemicals, or categories of facilities, if a different threshold is warranted (42 U.S.C. Š 11023(f)(2)). EPA has used this authority to establish lower thresholds for Persistent Bioaccumulative Toxic (PBT) chemicals. See 40 CFR 370.28, 64 FR 58666 and 66 FR 4500. The thresholds are determined separately for lead (using the weight of the metal) and for lead compounds (using the weight of the entire compound; 40 CFR 372.25(h)). For a lead compound(s) the *release* report should only contain information on the amount of lead contained in the compound(s), not the amount of the entire compound(s). Therefore, provided that the facility meets the SIC code and employee threshold criteria, reporting for <u>lead</u> is required:

- If a facility *manufactures, processes, or otherwise uses* more than 100 pounds of lead (<u>not</u> contained in stainless steel, brass, or bronze alloys) during the calendar year, or;
- If a facility *manufactures or processes* more than 25,000 pounds of lead (regardless of whether it is contained in stainless steel, brass, or bronze alloys) during the calendar year, or;
- If a facility *otherwise uses* more than 10,000 pounds of lead (regardless of whether it is contained in stainless steel, brass, or bronze alloys) during the calendar year.

Additionally, provided that the facility meets the SIC code and employee threshold criteria, reporting for the lead compounds category is required:

- If a facility *manufactures, processes, or otherwise uses* more than 100 pounds of lead compounds during the calendar year.

The threshold determination qualification for lead contained in stainless steel, brass, or bronze is described further in Section 3.0. If a threshold is exceeded for both lead and the lead compounds category, only a single EPCRA section 313 report needs to be prepared for lead compounds. Remember that if you exceed a threshold for lead compounds, you must report the quantity of the parent metal (lead) contained in the compound and that is released or otherwise managed as waste, not the quantity of the lead compound (40 CFR 372.25(h)).

The terms manufacture, process, and otherwise use are defined in 40 CFR 372.3 as:

Manufacture means to produce, prepare, import, or compound a toxic chemical. Manufacture also applies to a toxic chemical that is produced coincidentally during the manufacture, processing, otherwise use, or disposal of another chemical or mixture of chemicals, including a toxic chemical that is separated from that other chemical or mixture of chemicals as a byproduct, and a toxic chemical that remains in that other chemical or mixture of chemicals as an impurity.

Process means the preparation of a toxic chemical, after its manufacture, for distribution in commerce: (1) In the same form or physical state as, or in a different form or physical state from, that in which it was received by the person so preparing such substance, or (2) As part of an article containing the toxic chemical. Process also applies to the processing of a toxic chemical contained in a mixture or trade name product.

Otherwise use means any use of a toxic chemical, including a toxic chemical contained in a mixture or other trade name product or waste, that is not covered by the terms “manufacture” or

"process." Otherwise use of a toxic chemical does not include disposal, stabilization (without subsequent distribution in commerce), or treatment for destruction unless:

1) The toxic chemical that was disposed, stabilized, or treated for destruction was received from off site for the purposes of further waste management; or

2) The toxic chemical that was disposed, stabilized, or treated for destruction was manufactured as a result of waste management activities on materials received from off site for the purposes of further waste management activities. Relabeling or redistributing of the toxic chemical in which no repackaging of the toxic chemical occurs does not constitute otherwise use or processing of the toxic chemical.

Remember that the quantities of lead and lead compounds included in threshold determinations are not limited to the amounts released to the environment. All quantities of lead and lead compounds manufactured, processed, or otherwise used must be counted toward threshold determinations (EPCRA Section 313(a)). This may include lead compounds that are generated in closed systems. If you exceed any activity threshold for an EPCRA section 313 chemical or chemical category, you must file an EPCRA section 313 report for that chemical or chemical category, even if you have zero release and other waste management activity quantities. Exceeding the chemical activity threshold, not the quantity released or otherwise managed as waste, determines whether you must report.

To assist facilities in determining if they may need to report, Table 1-1 below lists some common potential industry and process sources of lead and lead compounds. Note that this table is not intended to be all-inclusive (see also Section 4.3). If you manufacture, process, or otherwise use lead or lead compounds in other operations you must consider the lead and lead compounds in threshold determinations. For more information on threshold determinations in general, see Section 2.0, and for information pertaining to threshold determinations when you process or otherwise use lead in stainless steel, brass, or bronze alloys, see Section 3.0.

Table 1-1

Industry and Process Sources of Lead and Lead Compounds

Industry/Process	Lead or Lead Compounds	Reference[1]
Metal mining: constituent in ore	Lead	3, 4
Smelting and refining: constituent in ore	Lead	3, 4
Coal mining: trace constituent in ore	Lead compounds	3, 4
Steel industry: coke production, trace constituent in coal	Lead compounds	3, 4
Fabricated metal products: article component (e.g., ammunition, galvanized products, pipe organs)	Lead and lead compounds	3, 4
Electronic product components (e.g, batteries, electroplating of printed circuit boards, solder)	Lead	3, 4
Other product components (e.g., blown glass, dental amalgam fillings, lead cable coating, lead oxides in pigments)	Lead and lead compounds	3, 4
Paper manufacturing: present in wood and chemicals	Lead	3, 4
Plastic materials and resin manufacture: formulation component	Lead compounds	3, 4
Chemical manufacture: organo-lead compound production, rubber, reactants, and catalysts	Lead and lead compounds	3, 4
Carbon black production: trace constituent in crude oil	Lead compounds	3
Petroleum refining: trace constituent in petroleum crude	Lead compounds	3, 4
Cement: trace constituent in raw materials	Lead	3, 4
Coal, oil, wood combustion (electric utilities, other facility electricity generation): traces in fuels	Lead and lead compounds	3, 4, 5
Waste treatment and solvent recovery: trace constituent in waste stream	Lead and lead compounds	3
Incineration of municipal and various industrial wastes	Lead and lead compounds	3, 4
Wholesale distribution of lead chemicals and compounds	Lead and lead compounds	3
Bulk petroleum stations: trace constituent in petroleum products	Lead compounds	3

[1]Numbers correspond to the references listed in Section 6.0.

Section 1.4 What Other Changes to the EPCRA Section 313 Reporting Requirements Apply to Lead and the Lead Compounds Category?

EPA has also made modifications and/or clarifications to certain reporting exemptions and requirements for the PBT chemicals that are subject to lower reporting thresholds; this includes lead and

the lead compounds category. Each of the changes as they apply to lead and the lead compounds category is discussed in the following subsections. Other EPCRA section 313 exemptions that are not discussed below (e.g., those about articles, uses, and laboratories as described in 40 CFR 372.38 (b), (c), and (d)) have not been changed as a result of the new rule (see also Section 2.1.2 of this document).

1.4.1 *De Minimis* Exemption

The *de minimis* exemption allows facilities to disregard certain minimal concentrations of toxic chemicals in mixtures or other trade name products they process or otherwise use when making threshold determinations and release and other waste management calculations (40 CFR 372.38(a)).

EPA eliminated the *de minimis* exemption for EPCRA section 313 PBT chemicals, including lead and the lead compounds category, except for lead contained in stainless steel, brass, or bronze alloys (40 CFR 372.38(a)). This means that facilities are required to include **all** amounts of lead and lead compounds (except for lead in stainless steel, brass, or bronze alloys as discussed in Section 3.0) in threshold determinations and **all** amounts of lead and the metal portion of lead compounds in release and other waste management calculations regardless of the concentration of lead and lead compounds in mixtures or trade name products (40 CFR 372.38(a)). However, the elimination of the *de minimis* exemption for reporting PBT chemicals does not affect the applicability of the *de minimis* exemption to the supplier notification requirements (e.g., for facilities that manufacture or sell toxic chemicals as described in 40 CFR 372.45), or to threshold or release calculations performed only on lead contained in stainless steel, brass, or bronze alloys.

1.4.2 Form A Exclusion

The "Alternate Threshold for Facilities with Low Annual Reportable Amounts," provides facilities otherwise meeting EPCRA section 313 reporting thresholds the option of filing a Form A (a two-page certification statement) instead of the more extensive Form R, provided that they do not exceed 500 pounds for the total annual reportable amount for that chemical, and that their amounts

manufactured, processed, or otherwise used for that chemical do not exceed one million pounds (40 CFR 372.27).

EPA has excluded EPCRA section 313 PBT chemicals, including lead and the lead compounds category (except for lead contained in stainless steel, brass, or bronze alloys), from eligibility for the "Alternate Threshold for Facilities with Low Annual Reportable Amounts" (40 CFR 372.27(c)). Therefore, submitting a Form A rather than a Form R is not an option for lead and the lead compounds category (unless you are only reporting the use of lead in the form of stainless steel, brass, or bronze alloys because you exceed the 25,000/10,000 pound threshold; once the 100 pound threshold for use of non-qualified alloys has been exceeded, the Form A cannot be used).

1.4.3 Range Reporting

For facilities with total annual releases or off-site transfers of an EPCRA section 313 chemical of less than 1,000 pounds, EPA allows the amounts to be reported on the Form R either as an estimate or by using range codes (A = 0 - 10 pounds, B = 11 - 499 pounds, and C = 500 - 1,000 pounds) (40 CFR 372.85(b)(15)(i)).

EPA has eliminated range reporting for releases and other waste management activities for EPCRA section 313 PBT chemicals, including lead and the lead compounds category, except for lead contained in stainless steel, brass, or bronze alloys. This means that for those sections of the Form R for which range reporting is an option, the option cannot be used when reporting on lead and/or the lead compounds category (40 CFR 372.85(b)(15)(i)) (unless you are only reporting on lead in the form of stainless steel, brass, or bronze alloys because you exceed the 25,000/10,000 pound threshold; once the 100 pound threshold for non-qualified alloys has been exceeded, range reporting cannot be used). Thus, facilities are required to report an actual number rather than a selected range. However, the elimination of range reporting for PBT chemicals does not affect the applicability of range reporting for the maximum amount on site as required by EPCRA section 313(g).

1.4.4 Data Precision

Facilities should report for lead and the lead compounds category at a level of precision supported by the data and the estimation techniques on which the estimate is based. However, the smallest quantity that should be reported on the Form R for lead or lead compounds (when the 100 pound threshold for non-qualified alloys has been exceeded) is 0.1 pounds. Note that EPA previously allowed facilities to "round off" release and other waste management estimates to zero if they were 0.5 pounds or less. This option is not allowed for PBT chemicals, including lead and the lead compounds category (64 FR 42236).

SECTION 2.0 GUIDANCE ON ESTIMATING THRESHOLDS AND ENVIRONMENTAL RELEASES OF LEAD AND LEAD COMPOUNDS

Section 2.1 General Guidance

EPA is providing the following guidance for use by facilities in estimating and reporting annual releases and other waste management quantities for lead and the lead compounds category. This document is not intended to provide complete guidance for all situations involving lead and lead compounds. Please consult industry-specific guidance documents applicable to your facility for more detailed guidance. Additional information and guidance is also available from the EPA's EPCRA Hotline, **1-800-424-9346**, and the Toxic Chemical Release Inventory (TRI) website at **http://www.epa.gov/tri**. EPA also publishes an annual guidance document for EPCRA section 313 reporting entitled *Toxic Chemical Release Inventory Reporting Forms and Instructions*. You should consult the most current version before preparing any report for your facility.

This document includes concentration and emission factor data which may be used as default values in calculating activity thresholds, releases and other waste management quantities. EPA recommends that facilities complete these calculations using best readily available information applicable to their operations, even when it differs from the data provided herein. EPA also recommends that facilities maintain documentation of the basis for making these estimates. Facilities are not required to perform additional testing for EPCRA section 313 reporting.

2.1.1 Threshold Determination

As mentioned in Section 1.3, EPA lowered the reporting threshold for lead and the lead compounds category to 100 pounds per year for each of the reporting activities (manufacturing, processing, and otherwise use). Each activity threshold is determined independently. When determining if a threshold is exceeded for lead, you should calculate the amount of lead manufactured, the amount of lead processed, and the amount of lead otherwise used. These calculations must be conducted separately for lead and for lead compounds. To determine if a threshold is exceeded for the lead

compounds category, use the entire weight of the lead compound for each threshold determination (40 CFR 372.25(h)). (Some typical quantities required to meet the threshold for fuels and other selected materials may be found in Table 4-8.) In reporting releases and other waste mangagement activities, however, the quantities of lead can be combined, and submission of only one form R is necessary. The following example illustrates a few key points for threshold determinations for lead metal versus the lead compounds category.

Example - Threshold Determinations For Lead Metal Versus Lead Compounds.

During the calendar year, your facility: manufactures 5 pounds of a lead compound (PbO); processes 200 pounds of a material containing 55% lead metal (Pb) (not contained in stainless steel, brass, or bronze alloys); processes 99 pounds of another lead compound (PbS); otherwise uses 50 pounds of lead metal; and otherwise uses 8 pounds of another lead compound (Pb_3O_4). For completeness, you should calculate the manufacturing, processing, and otherwise use thresholds for lead metal and lead compounds separately, as shown below:

Lead Metal

Manufacturing: None specified above.
Processing: 200 lbs of Pb × 0.55 = 110 lbs of Pb.
Otherwise Use: Given above as 50 lbs of Pb.

Lead Compounds

Manufacturing: Given above as 5 lbs of PbO.
Processing: Given above as 99 lbs of PbS.
Otherwise Use: Given above as 8 lbs of Pb_3O_4.

The only threshold that your facility exceeded was the 100 lb threshold for processing of lead (metal). This means you must submit an EPCRA section 313 report for lead, and you must calculate all releases and other non-exempt waste management activity quantities of lead from your facility, including releases from the otherwise use activity for lead metal (40 CFR 372.85(b)(15)(i)). You do not have to report releases and other waste management activity quantities of lead associated with the lead compounds that you manufactured, processed, and otherwise used because you did not exceed any thresholds for lead compounds.

However, if your facility had processed 100 lbs or more of PbS (instead of 99 pounds), you would have also exceeded the threshold for processing lead compounds and you would have to report all releases and other non-exempt waste management activity quantities of lead from the lead compounds that you manufactured, processed, and otherwise used. If your facility exceeds a threshold for both lead and lead compounds, you are allowed to prepare one Form R report that accounts for your releases of lead resulting from all of your non-exempt activities involving both lead and lead compounds. In this case, the lead associated with your activities involving lead compounds include:

Lead Associated With Activities Involving Lead Compounds

Manufacturing: 5 lbs of PbO × (207.2; mol. wt. Pb/223.2; mol. wt. PbO) = 4.6 lbs Pb
Processing: 100 lbs PbS × (207.2; mol. wt. Pb/239.26; mol. wt. PbS) = 86.6 lbs Pb
Otherwise Use: 8 lbs of Pb_3O_4 × (621.6; mol. wt. of 3Pb/685.6; mol. wt. of Pb_3O_4) = 7.3 lbs of Pb

If you burn fuels (e.g., coal or oil) on site, lead present as an impurity in the fuel forms a lead compound that is coincidentally manufactured and subsequently released or otherwise managed as waste. If you do not know in what form lead is present in a fuel, EPA recommends in most cases assuming elemental lead. For combustion of fuels that contain lead, assume that lead is converted to lead compounds (5). In the absence of any other data, EPA recommends assuming that lead dioxide (PbO_2) is formed, and use that for threshold calculations. The amount of lead compounds formed should be applied to the manufacturing threshold for lead compounds. Note that the *de minimis* exemption cannot be applied to compounds that are coincidentally manufactured as impurities (40 CFR 372.38(a)). The following example also demonstrates this issue. See Section 4.5 for more information pertaining to combustion of fuels containing lead.

Example - Determining the Amount of Lead Combusted and Lead Dioxide Formed

Your facility operates several coal-fired boilers to produce heat, steam, and electricity (coal is not directly processed or used in your production process). The supplier of the coal provided you with an MSDS stating that the lead content of the coal is 7 ppmw. Using inventory records, you know that 13,600,000 pounds of coal were burned in this boiler during the calendar year. You have otherwise used 13,600,000 pounds of coal and in the process, as discussed above, we assume you have coincidentally manufactured PbO_2 during the combustion of the coal. Two threshold calculations must be performed as follows:

Otherwise Use of Lead (Pb):

$$(7 \text{ lb lead}/1 \times 10^6 \text{ lb coal}) \times 13{,}600{,}000 \text{ lb coal/yr} = 95.2 \text{ lb lead/yr}$$

Manufacturing of Lead Compounds (PbO_2):

$$95.2 \text{ lb lead/yr} \times (239.2; \text{mol. wt. } PbO_2/207.2; \text{mol. wt. Pb}) = 110 \text{ lb } PbO_2/\text{yr}$$

While your facility did not exceed the 100 lb/yr threshold for otherwise using lead (in coal), your facility exceeded the 100 lb/yr threshold for manufacturing lead compounds and you will have to file an EPCRA section 313 report for lead compounds this year.

The concentration of lead or lead compounds may be known as a specific concentration, as an average, as a range, or as an upper or lower boundary. If you know the specific concentration of lead or lead compounds, you must use that value for estimates (40 CFR 372.30 (b)(i)). If only an average concentration is provided (e.g., by the supplier), use that value in the threshold calculation. If only the upper-bound concentration is known, you must use that value in the threshold calculation (40 CFR 372.30(b)(3)(ii)). If only the lower-bound concentration is known, or the concentration is given as a

range of an upper and lower boundary, EPA has developed the following guidance on the use of this type of information in threshold determinations.

- If the concentration is given as a range or an upper and lower boundary, EPA recommends that you use the mid-point in your calculations.

- If only the lower bound concentration of lead or lead compounds is given and the concentrations of the other components are given, EPA recommends that you subtract the other component total from 100% to calculate the upper bound of the lead or lead compound(s). EPA then recommends that you determine the mid-point for use in your calculations.

- If only the lower-bound concentration of lead or lead compounds is given and the concentration of the other components is not given, EPA recommends that you assume the upper bound for the lead or lead compounds is 100% and use the mid-point. Alternatively, product quality requirements or information available from the most similar process stream may be used to determine the upper bound of the range.

Example - Determining the Amount of Lead Processed

Your facility processes a chemical substance that contains lead. You have information indicating that the lead content of the chemical substance is 0.022 to 0.026 percent by weight. Using inventory records, you know that 750,000 pounds of the chemical substance was processed at your facility during the calendar year. Using the mid-point of the range of lead concentrations available (0.024), you determine if you have exceeded the processing threshold.

(0.024 lb lead/lb chemical substance) × 750,000 lb chemical substance/yr = 18,000 lb lead/yr

Your facility exceeded the 100 lb/yr processing threshold for lead and will have to report for lead this year.

Chemical production facilities may manufacture lead compounds for other industry use. Production records are a good source for determining the amount manufactured. You must also include the importing of lead or lead compounds in your manufacturing threshold determination. (EPCRA Section 313(b)(1)(C)(i)). You can obtain these amounts from purchasing records.

2.1.2 Exemptions

EPA has established four classes of exemptions: *de minimis*, article, facility/laboratory related, and activity related. EPCRA section 313 chemicals or chemical categories that qualify for these

exemptions may be excluded from threshold determinations and release or other waste management estimations.

The final lead rule states that the *de minimis* exemption does not apply to PBT chemicals or chemical categories (40 CFR 372.38(a)), except for lead contained in stainless steel, brass, or bronze alloys (see Section 3.0).

For the purpose of the article exemption, an article is defined as a manufactured item that:

- Is formed to a specific shape or design during manufacture;
- Has end-use functions dependent in whole or in part upon its shape or design; and
- Does not release an EPCRA section 313 chemical or chemical category under normal conditions of processing or otherwise use of the item at the facility (40 CFR 372.3).

If you receive a manufactured article from another facility (e.g., a battery containing lead), the lead in that article may be exempt from threshold determinations and release and other waste management calculations if you meet the following criteria:

- You process or otherwise use it without changing the shape or design; and
- Your processing or otherwise use does not result in the release of more than 0.5 pounds of lead or any other TRI chemical in a reporting year from all like articles.

Recycling of releases from articles allows them to remain as exempt articles (1).

Any lead or lead compounds manufactured, processed, or otherwise used in laboratories under the supervision of a technically qualified individual may be exempt from threshold determinations and release and other waste management calculations (40 CFR 372.38(d)). Note that the laboratories exemption does not apply in the following cases:

1) Specialty chemical production;

2) Manufacture, processing, or use of toxic chemicals in pilot plant scale operations; and,
3) Activities conducted outside the laboratory.

The activity-related exemptions are available for lead and lead compounds (see 40 CFR 372.38(c) for a description of each). The activity-related exemptions include such uses as materials that are structural components of the facility, materials used for janitorial or facility grounds maintenance, materials used to operate motor vehicles, and materials used only for personal use.

In addition to the four exemptions discussed above, EPA has established guidance for two special circumstances that may apply to facilities manufacturing, processing, or otherwise using lead. This guidance applies to coal extraction and metal mining activities. Regarding coal extraction, per 40 CFR 372.38(g), if a toxic chemical is manufactured, processed, or otherwise used in extraction by facilities in SIC code 12, a person is not required to consider the quantity of the toxic chemical so manufactured, processed, or otherwise used when determining whether an applicable threshold has been met under § 372.25, § 372.27, or § 372.28, or determining the amounts to be reported under § 372.30. For additional information regarding coal extraction, refer to *Section 313 Emergency Planning and Community Right-to-Know Act Guidance for Coal Mining Facilities*. This document is available on the TRI Home Page (http://www.epa.gov/TRI).

Regarding metal mining overburden, per 40 CFR 372.38(h), if a toxic chemical that is a constituent of overburden is processed or otherwise used by facilities in SIC code 10, a person is not required to consider the quantity of the toxic chemical so processed, or otherwise used when determining whether an applicable threshold has been met under § 372.25, § 372.27, or § 372.28, or determining the amounts to be reported under § 372.30. For additional information regarding metal mining, refer to *Section 313 Emergency Planning and Community Right-to-Know Act Guidance for Metal Mining Facilities*. This document is available on the TRI Home Page (http://www.epa.gov/TRI).

Section 2.2 Methods for Calculating Annual Releases and Other Waste Management Quantities of Lead

When reporting releases and other waste management quantities for lead or the lead compound category, only the amount of elemental lead needs to be reported on the Form R (40 CFR 372.2(h)). EPA recommends that you calculate lead releases and other waste management activities by following these steps:

1. Identify the processes/operations where lead or lead compounds may be manufactured, processed, or otherwise used.

2. Determine potential sources of releases and other waste management activities from these processes (e.g., process wastewater discharge, emissions from operations).

3. Identify the types of releases and other waste management activities. These types correspond to the Form R sections (e.g., stack emissions, quantity sent off site for recycling).

4. Determine the most appropriate estimation method(s) and calculate the estimates for release and other waste management quantities.

During threshold determinations, you should have identified the processes and operations in which lead (and lead compounds) are found. Potential release and other waste management sources of lead include the following:

Accidental spills and releases	Recycling and energy recovery by-products
Air pollution control devices (e.g., baghouses, electrostatic precipitators, and scrubbers)	Storage tanks
Clean up and housekeeping practices	Tower stacks
Combustion by-products	Transfer operations
Container residues	Treatment sludge
Fittings and pumps	Volatilization from processes
Process discharge stream	Waste treatment discharges

After determining the release and other waste management activity sources of lead and lead compounds, you are ready to determine the types of releases and other waste management activities. These final destinations of lead (not including incorporation into a final product) correspond to elements of the Form R. The potential types of releases and other waste management activities include:

- Fugitive or nonpoint air emissions (Part II, Section 5.1 of Form R): Lead emissions are considered to be fugitive if not released through stacks, vents, ducts, pipes, or any other confined air stream. You must include (1) fugitive equipment leaks from valves, pump seals, flanges, compressors, sampling connections, open-ended lines, etc.; (2) evaporative losses from surface impoundments and spills; (3) releases from building ventilation systems; and (4) any other fugitive or non-point air emissions.

- Stack or point air emissions (Part II, Section 5.2 of Form R): Lead emissions are considered to be stack or point emissions if released through stacks, confined vents, ducts, pipes, or other confined air streams. You must include storage tank emissions. Air releases from air pollution control equipment would generally fall in this category. Using the control efficiency of an air pollution control device, you can determine how much lead is released through the air device.

- Discharges to receiving streams or water bodies (Part II, Section 5.3 of Form R): Lead may be released in wastewater directly from the process or from a treatment system. Monitoring is often performed at either type of outfall. This information can be used to determine the concentration of lead leaving the facility.

- Underground injection on site (Part II, Section 5.4 of Form R): This waste management type is not common for lead and lead compounds. However, if applicable you must report the quantity to various classes of underground injection wells.

- Disposal to land on site (Part II, Section 5.5 of Form R): This type of release may occur if materials containing lead or lead compounds are spilled during processing or transfer operations.

- Discharges to Publicly Owned Treatment Works (POTW) (Part II, Section 6.1 of Form R): As with the receiving stream discharge, monitoring data may be available to determine the lead concentration in a waste stream from a process or from a treatment operation.

- Transfers to other off-site locations (Part II, Section 6.2 of Form R): This type includes transferring lead off site for disposal, treatment, energy recovery, or recycling. Sources include baghouse and electrostatic precipitator dust sent to landfills, and scrap metal sent for recycle or disposal. Section 6.2 includes quantities of TRI chemicals that are sent for energy recovery. However, lead and most lead compounds do not contain enough latent heat content to be

considered useful for these operations (they have low heats of combustion). Therefore, in most cases lead and lead compounds should not be reported for energy recovery.

- On-site waste treatment (Part II, Section 7A of Form R): You should report the amount of lead treated by your facility. Following treatment, lead may be present in sludge or the water (at a reduced concentration). Typically, EPA considers the removal of particulate matter from a gas stream (e.g., by a baghouse or electrostatic precipitator) to be an on-site treatment operation. Therefore, any lead or lead compounds in the particulate matter has been "treated on site" and should be reported in Section 7A of the Form R.

- On-site energy recovery (Part II, Section 7B of Form R): EPA believes that chemicals that do not contribute significant heat energy during the combustion process should not be considered for energy recovery. Therefore, lead and the metal portion of lead compounds should not be reported as combusted for energy recovery.

- On-site recycling (Part II, Section 7C of Form R). If you perform lead recycling (for example the remelting of scrap metal generated on-site), you should report the amount recycled in Section 7C of the Form R.

After you have identified all of the potential sources for release and other waste management activity types, you must estimate the quantities of lead and the lead portion of lead compounds released and otherwise managed as waste. EPA has identified four basic methods that may be used to develop estimates (each method has been assigned a code that must be included when reporting). The methods and corresponding codes are:

- Monitoring Data or Direct Measurement (M);
- Mass Balance (C);
- Emission Factors (E); and,
- Engineering Calculations (O).

Descriptions of these techniques are provided in the U.S. EPA publication, *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Forms* (6) and in the annual *TRI Reporting Forms and Instruction* documents.

Many data sources exist for these (and other) methods of developing estimates. Table 2-1 presents potential data sources and the estimation methodology in which each estimation source is most likely to prove useful. Based on site-specific knowledge and potential data sources available, you

should be able to determine the best method for calculating each release and other waste management activity quantity.

Table 2-1

Potential Data Sources for Release and Other Waste Management Calculations

DATA SOURCES	
Monitoring Data	**Mass Balance**
C Air permits	C Air emissions inventory
C Continuous emission monitoring	C Hazardous material inventory
C Effluent limitations	C Hazardous waste manifests
C Hazardous waste analysis	C MSDSs[5]
C Industrial hygiene monitoring data	C Pollution prevention reports
C NPDES[1] permits	C Spill event records
C Outfall monitoring data	C Supply and purchasing records
C POTW pretreatment standards	
C RCRA[2] permit	**Engineering Calculations**
C Stack monitoring data	C NTI[6] database
C New Source Performance Standards	C Facility non-chemical specific emission factors.
C Title V Permit Data	C Henry's Law
C MACT[3] Standards	C Raoult's Law
	C SOCMI[7] or trade association non-chemical specific emission factors
Emission Factors	
C AP-42[4] chemical specific emission factors	C Solubilities
C Facility or trade association derived chemical-specific emission factors	C Volatilization rates

[1]National Pollutant Discharge Elimination System.
[2]Resource Conservation Recovery Act.
[3]Maximum Achievable Control Technology.
[4]Compilation of Emission Factors, U.S. EPA.
[5]Material Safety Data Sheets.
[6]National Toxic Inventory.
[7]Synthetic Organic Chemicals Manufacturing Industry.

SECTION 3.0 QUALIFICATION FOR STAINLESS STEEL, BRASS, AND BRONZE ALLOYS THAT CONTAIN LEAD

Lead and lead compounds have been characterized by EPA as persistent bioaccumulative and toxic (PBT) substances. The final lead rule lowered the 25,000 lb manufacturing/processing and 10,000 lb otherwise use reporting thresholds for lead and lead compounds to 100 lbs. The basis for the 100 lb threshold is discussed in detail in Section VI. (page 42232) of the Preamble to the proposed lead rule (7). EPA's responses to public comments pertaining to the 100 lb threshold are discussed on page 4530 of the Preamble to the final lead rule (2). The 100 lb reporting threshold applies to lead and all lead compounds except for lead contained in stainless steel, brass, and bronze alloys (2).

It is important to note that stainless steel, brass and bronze alloys, even when they contain lead, are not included on the EPCRA section 313 list of toxic chemicals: they are not listed chemicals. Lead, of course, is included on the EPCRA section 313 list of toxic chemicals, and its presence in stainless steel, brass or bronze alloys does not change its status as a listed chemical, or as a PBT chemical. Thus, the reporting threshold regarding lead contained in stainless steel, brass or bronze alloys pertains to the quantity of lead in these alloys, and not the quantity of the alloy. EPA deferred on lowering the reporting threshold for lead in stainless steel, brass, and bronze alloys because the Agency is currently evaluating a previously submitted petition as well as comments received in response to previous petition denials that requested the Agency to revise the EPCRA section 313 reporting requirements for certain metals contained in stainless steel, brass, and bronze alloys. EPA is currently reviewing whether there should be any reporting changes regarding the listed constituents (e.g., lead) of stainless steel, brass and bronze alloys.

Although the 100 lb threshold does not apply to lead while it is in stainless steel, brass and bronze alloys, there may be certain activities that involve these alloys in which the 100 lb threshold will impact reporting. This section provides a general discussion on what stainless steel, brass and bronze alloys are, and provides specific details and guidance that will enable one to determine whether the 100 lb threshold applies and/or 25,000 lb/10,000 lb threshold applies. A more detailed discussion on the composition of stainless steel, brass and bronze alloys is provided in Appendix A. A comprehensive

discussion on the chemistry, composition, and environmental fate of alloys, including stainless steel, brass and bronze alloys is available in a recently released EPA Report on the Corrosion of Certain Alloys (8).

The definition of "alloy" is: an intentional mixing of two or more chemical elements that have at least one metallic property; examples being stainless steel, brass, and bronze, which are three of the most commonly used alloys (9). The major metal in stainless steel is iron; however, depending on the type of stainless steel there can be substantial amounts of chromium and/or nickel, which are added to minimize the corrosion of the stainless steel. The major metal in brass and bronze is copper; however, substantial amounts of nickel and/or zinc may also be present. Brass is an alloy of copper and zinc with other metals in varying lesser amounts. Bronze is an alloy of copper and tin with smaller amounts of other metals.

Definition of Stainless Steel Alloy

The American Iron and Steel Institute (AISI) defines alloy steels as follows: "by common custom steel is considered to be alloy steel when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: manganese (Mn), 1.65%; silicon (Si), 0.60%; copper (Cu), 0.60%; or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum (Al), boron (B), chromium (Cr) up to 4.00%, cobalt (Co), niobium (Nb), molybdenum (Mo), nickel (Ni), titanium (Ti), tungsten (W), vanadium (V), zirconium (Zr), or any other alloying element added to obtain a desired alloying effect." Steels that contain 4.00% or more of chromium are included, by convention, among the special types of alloy steels known as **stainless steels** (8).

More then 180 different alloys belong to the stainless steel group and each year new ones and modifications of existing ones appear. In some stainless steels the chromium content now approaches 30%. The major characteristics of stainless steels, containing at least 11% chromium, are corrosion and oxidation resistance, which increase as the chromium content is increased. The main reason for the existence of stainless steels is their resistance to corrosion. By increasing the amount of the chromium

content and by the presence of other elements, such as molybdenum or titanium, the corrosion resistance of stainless steels can be varied over a tremendous range.

Definitions of Brass and Bronze

Brass is an alloy that consists chiefly of copper and zinc in variable proportions, and to a lesser extent other elements. **Bronze** is an alloy that consist chiefly of copper and tin in variable proportions, and to a lesser extent other elements. There are a number of different types of brass and bronze that differ in the concentrations of copper, zinc, tin or other metals.

Classification of Brass and Bronze

Copper and its alloys, including brass and bronze, are classified in the United States by composition according to Copper Development Association (CDA) designations which have been incorporated into the Unified Numbering System (UNS) for metals and alloys. Wrought copper materials are assigned five digit numerical designations which range from C10100 through C79999, but only the first three or sometimes four numerals are frequently used for brevity. Designations that start with 8 or 9 are reserved for cast copper alloys. The designations and principal alloying elements of wrought copper alloys are given in Table 3-1.

Table 3-1

UNS (CDA) Designations for Brass and Bronze Alloys

Alloy group	UNS (CDA) designation	Principal alloy elements
Brasses	C20500-C28580	Zn
Leaded brasses	C31200-C38590	Zn-Pb
Tin brasses	C40400-C40980	Sn, Zn
Phosphor bronzes	C50100-C52400	Sn-P
Leaded bronzes	C53200-C54800	Sn-P, Pb
Phosphorus-silver	C55180-C55284	Ag-P
Aluminum bronze	C60600-C64400	Al, Fe, Ni, Co, Si
Silicon bronze	C64700-C66100	Si, Sn
Modified brass	C66400-C69950	Zn, Al, Si, Mn

Brass and bronze can be grouped according to how the principal elemental additions affect properties. This grouping depends primarily on whether the additions that dissolve in the liquid copper can form discrete second phases during melting/casting or in-process thermal treatment. Brass and bronze are considered to be solid solution alloys when copper dissolves other elements to varying degrees to produce a single-phase alloy that is strengthened relative to unalloyed copper. The contribution to strengthening from an element depends on the amount of the element in solution and by its particular physical characteristics, such as atom size and valency. Tin, silicon, and aluminum show the highest strengthening efficiency of the common elemental additives, whereas nickel and zinc are the least efficient. The limiting factor in their alloy range is the extent to which the elements, either singly or in combination, remain dissolved in the copper during processing. Table 3-2 gives the designations and compositions of some specific brass and bronze wrought alloys. More details on these specific alloys are provided in Appendix A.

Table 3-2

UNS (CDA) Designation and Compositions of Some Brass and Bronze Wrought Alloys

Alloy group	UNS designation	Elemental composition, wt%[a]
Zinc brass	C260	30 Zn
Leaded brass	C360	35 Zn, 3 Pb
Tin brass	C425	9.5 Zn, 2.0 Sn
Phosphor bronze	C510	5.0 Sn, 0.1 P
Aluminum bronze	C638	2.8 Al, 1.8 Si
Silicon bronze	C654	3.0 Si, 1.5 Sn, 0.1 Cr
Silicon bronze	C655	3.3 Si, 0.9 Mn
Modified Cu-Zn	C688	22.7 Zn, 3.4 Al, 0.4 Co

[a]Remaining percentage is copper.

Application of the 100 lb, and 25,000 lb/ 10,000 lb Activity Thresholds for Determining if Reporting is Required for Lead and Lead Compounds.

A facility must file an EPCRA section 313 report if it manufactures, processes, or otherwise uses 100 pounds or more of lead (not contained in stainless steel, brass, or bronze alloy) during the calendar year. For lead contained in stainless steel, brass or bronze alloy the 25,000 lb threshold for manufacturing and processing, and the 10,000 lb threshold for otherwise use, is applied. It is important to note, however, for facilities that manufacture, process, or otherwise use lead or lead compounds and stainless steel, brass, or bronze alloys that contain lead, that all quantities of lead and lead compounds (regardless of whether they are in an alloy) must still be applied to the 25,000 pound threshold for manufacturing and processing or the 10,000 pound threshold for otherwise use. When conducting threshold evaluations a facility must consider the amount of lead not in stainless steel, brass, or bronze alloy toward both the 100 pound threshold AND the 25,000 and 10,000 pound thresholds.

This qualification creates three potential scenarios for facilities that manufacture, process, or otherwise use lead or lead compounds and stainless steel, brass or bronze alloys that contain lead: 1) all lead is in forms other than stainless steel, brass, or bronze alloy; 2) all lead is in stainless steel, brass, or bronze alloy; and 3) some lead is in stainless steel, brass, or bronze alloy and some is not; i.e., some lead or lead compounds may be manufactured, processed, or otherwise used elsewhere at the facility. Table 3-3 describes these three reporting scenarios and explains the resulting implications of reporting under each scenario.

Table 3-3 refers to the following **reporting variables**: Form A and range reporting for Sections 5 and 6 of Part II of the Form R. The Form A refers to an alternate threshold that allows eligible facilities the option of submitting a simplified Certification Statement instead of the full Form R report for non-PBT chemicals (see Section 1.4.2 for more information on Form A reports). Range reporting refers to the use of designated letter codes representing defined ranges of releases and quantities otherwise managed as waste less than 1,000 pounds (i.e., A = 1-10, B = 11 - 499, or C = 500 - 999 pounds) rather than reporting a specific value.

Table 3-3

Lead Alloy Threshold Calculation Scenarios and Reporting Effects

Scenario	Effects
No lead in qualified alloys. All lead quantities included in the threshold determination are "not in stainless steel, brass, or bronze alloys." (Both the 100 pound and the 25,000/10,000 pound thresholds need to be considered, but, obviously, if only non-qualified alloy lead is included then the facility will trip the 100 pound threshold before tripping the 25,000/10,000 pound threshold.)	In this scenario, the facility may NOT use ANY of the following **variables**: *de minimis* exemption, Form A, and range reporting for Sections 5 and 6 of Part II of the Form R.
All lead is in qualified alloys. All lead quantities included in the threshold determination are "in stainless steel, brass, or bronze alloys." (Only the 25,000/10,000 pound threshold needs to be considered, and assume, for purposes of this example, that either the 25,000 or 10,000 pound threshold is exceeded.)	The facility can use the *de minimis* exemption (if otherwise applicable). The facility may also use the following **reporting variables**: Form A and range reporting for Sections 5 and 6 of Part II of the Form R.
Lead in qualified alloys AND lead not in qualified alloys. Quantities of lead are found "in stainless steel, brass or bronze alloys" *and* "not in stainless steel, brass, or bronze alloys". All lead quantities are included in the threshold determination. (For those quantities of lead not in the specified alloys both the 100 pound and the 25,000/10,000 pound thresholds need to be considered. For those quantities of lead in the specified alloys only the 25,000/10,000 pound threshold needs to be considered.)	The facility may take the *de minimis* exemption for those quantities of lead "in stainless steel, brass, or bronze alloys" that meet the *de minimis* exemption requirements (*e.g.*, manufactured as an impurity). The facility may not take the *de minimis* exemption for any of the lead "not in stainless steel, brass, or bronze alloys." The facility may NOT use the following **reporting variables**: Form A and range reporting for Sections 5 and 6 of Part II of the Form R once the 100 pound threshold is exceeded, regardless of whether the 25,000/10,000 pound threshold is also exceeded. If only the 25,000/10,000 pound threshold is exceeded, the facility may use the **reporting variables** even though, in this example, quantities of lead "not in stainless steel, brass, or bronze alloys" were included. The reporting variables cannot be used once the 100 lb threshold has been exceeded.

The following example demonstrates some potential threshold determination scenarios both including and excluding lead contained in stainless steel, brass, and bronze alloys. Other examples are included in Appendix B, which presents a series of questions and answers regarding the reporting of lead and lead compounds. The first part of Appendix B repeats selected questions and answers about

EPCRA section 313 reporting of metal and metal compounds that have been published elsewhere (1) while the second part of Appendix B presents questions and answers received by the Agency since the promulgation of the lead rule that are specific to the reporting of lead and lead compounds and that have not yet been published elsewhere.

Example - Threshold Determinations for Various Scenarios Involving Lead Alloys.

1) Your facility processes 105 pounds of lead in a form other than in stainless steel, brass, or bronze alloys during the calendar year. Do you have to file an EPCRA section 313 report for lead?

Yes, you must file an EPCRA section 313 Form R report for lead (a Form A report is not an option for you). You have exceeded the 100 pound threshold for reporting your processing of lead in forms other than in stainless steel, brass, or bronze alloys.

2) Your facility processes 25,010 pounds of lead in a stainless steel alloy (and less than 100 pounds is in the form of lead itself or a lead compound) during the calendar year. Do you have to file an EPCRA section 313 report for lead?

Yes, you must file an EPCRA section 313 report for lead. You have exceeded the 25,000 pound threshold for reporting your processing of lead in "all forms, including stainless steel, brass, and bronze alloys", therefore, you must file a report. Since you have not exceeded the 100 pound threshold for reporting your processing of lead in forms other than stainless steel, brass, or bronze alloys, or in the form of lead itself or a lead compound, you may file a Form A report rather than a Form R report if you meet the other requirements (less than 1,000,000 pounds manufactured, processed, or otherwise used and less than 500 pounds for the total annual reportable amount) for completing a Form A report.

3) Your facility processes 95 pounds of lead itself or lead compounds (not in stainless steel, brass, or bronze alloys) and 24,910 pounds of lead in a stainless steel alloy during the calendar year. Do you have to file an EPCRA section 313 report for lead?

Yes, you must file an EPCRA section 313 report for lead. You have exceeded the 25,000 pound threshold for reporting your processing of lead in "all forms, including stainless steel, brass, and bronze alloys" (95 pounds not in a qualified alloy plus 24,910 pounds in stainless steel = 25,005 pounds total), therefore, you must file a report. Since you have not exceeded the 100 pound threshold for reporting your processing of lead in forms other tah in stainless steel, brass, or bronze alloys, you may file a Form A report rather than a Form R report if you meet the other requirements (less than 1,000,000 pounds manufactured, processed, or otherwise used and less than 500 pounds for the total annual reportable amount) for completing a Form A report.

4) Your facility processes 275 pounds of lead that is not in stainless steel, brass, or bronze alloys and in a separate operation processes 24,900 pounds of lead in a brass alloy during the calendar year. Do you have to file an EPCRA section 313 report for lead and are you required to report quantities released and otherwise managed as waste from the lead in all sources?

Yes, you must file a Form R report for lead and you must consider all releases and quantities otherwise managed as waste from the lead in all sources. You exceeded the 100 pound threshold for lead not contained in stainless steel, brass, or bronze alloys; therefore, you must complete a Form R (you cannot use a Form A). Further, you must consider the amount of lead in the brass alloy when estimating the reportable amounts (although you can use the *de minimis* exemption for waste streams that apply to the 24,900 pounds of lead in the brass, if appropriate).

SECTION 4.0 SOURCES OF LEAD AND LEAD COMPOUNDS

This section provides an overview of where EPA believes lead and lead compounds are likely to be found at facilities and what operations may manufacture, process, or otherwise use lead or lead compounds. You should determine if these sources apply to your facility. EPA recognizes that this document is not exhaustive and that many additional sources of lead and lead compounds exist. You should carefully consider all potential sources, not just those discussed in this document.

Section 4.1 Physical and Chemical Nature of Lead and Lead Compounds

In pure form metallic lead is silvery in appearance. Metallic lead oxidizes and turns bluish-gray when exposed to air. It is soft enough to be scratched with a fingernail. It is dense, malleable, and readily fusible (10). Its properties include a low melting point; ease of casting; high density; low strength; ease of fabrication; acid resistance; electrochemical reaction with sulfuric acid; chemical stability in air, water, and soils; and the ability to attenuate sound waves, atomic radiation and mechanical vibration (11). The physical properties of lead are presented in Table 4-1.

Lead in its elemental or pure form rarely occurs in nature. Lead most commonly occurs as the mineral galena (lead sulfide [PbS]), and is sometimes found in other mineral forms, which are of lesser commercial importance, such as anglesite ($PbSO_4$) and cerussite ($PbCO_3$) (10). Table 4-2 presents properties of these three mineral compounds.

Lead is hardened by alloying it with small amounts of arsenic, copper, antimony, or other metals (10). These alloys are frequently used in manufacturing various lead-containing products. A list of typical end uses for lead alloys is given in Table 4-3.

Table 4-1

Physical Properties of Lead

Property	Value
Atomic weight	207.2 daltons
Melting point	327EC
Boiling point	1770EC
Specific gravity	
20EC	11.35 g/cm^3
327EC (solid)	11.00 g/cm^3
327EC (liquid)	10.67 g/cm^3
Specific heat	130 J/(kg-K)[a]
Latent heat of fusion	25 J/g[a]
Latent heat of vaporization	860 J/g[a]
Vapor pressure	
980EC	0.133 kPa[b]
1160EC	1.33 kPa[b]
1420EC	13.33 kPa[b]
1500EC	26.7 kPa[b]
1600EC	53.3 kPa[b]
Thermal conductivity	
28EC	34.7 W/(m-K)
100EC	33.0 W/(m-K)
327EC (solid)	30.5 W/(m-K)
327EC (liquid)	24.6 W/(m-K)
Thermal conductivity (relative to Ag = 100)	8.2
Coefficient of linear expansion, at 20EC per EC	29.1x10^{-6}
Surface tension at 360EC, mN/m (= dyn/cm)	442

Source: Reference 12

[a] To convert J to cal, divide by 4.184.
[b] To convert kPa to mm Hg, multiply by 7.5.

Table 4-2

Physical Properties of the Principal Lead-Ore Compounds

Parameter	Galena	Cerussite	Anglesite
Formula	PbS	$PbCO_3$	$PbSO_4$
Lead, weight percent	86.6 %	77.5 %	68.3 %
Hardness, Mohs scale	2.5 to 2.75	3 to 3.5	2.5 to 3
Luster	Metallic	Adamantine to vitreous, resinous	Adamantine to vitreous, resinous
Color	Lead gray	Colorless to white	Colorless to white
Density, g/cm^3	7.58	6.55	6.38

Source: Reference 13

Lead in its compound form also has many uses in manufacturing processes, primarily as pigments. Lead compounds can be classified into the following general categories:

- Organolead compounds;
- Lead oxides;
- Lead sulfides; and
- Lead salts.

Each of these classes of lead compounds is discussed briefly below. Table 3-4 presents a summary of the chemical formulas and end uses of the most commonly used lead compounds.

4.1.1 Organolead Compounds

Organolead compounds are distinctive with at least one lead-carbon bond. Only two types of organolead compounds have found large-scale commercial applications: tetramethyllead (TML) and tetraethyllead (TEL). However, with the removal of lead from

Table 4-3

Uses of Lead Alloys

Alloy	Uses
Lead - Copper	
<0.10% copper by wt.	Lead sheet Lead pipes Sheathings for electric power cables Wire and other fabricated lead products Tank linings Tubes for acid-mist precipitators Steam heating pipes for acid-plating baths
60 to 70% copper by wt. (leaded brass or bronze)	Bearings and bushings
Lead - Antimony	Lead-acid battery positive grids, posts, and connectors Flashings and roofing materials Cable sheathings Ammunition Tank linings, pumps, valves, pipes, and heating and cooling coils in chemical operations using sulfuric acid or sulfate solutions at elevated temperatures Lead sheet Anodes in metal-plating and metal-electrowinning operations Collapsible tubes Wheel-balancing weights for automobiles and trucks Special weights and castings Battery cable clamps
Lead - Antimony - Tin	Printing-type metals Bushing and sleeve bearings Journal bearings in freight cars and mobile cranes Decorative, slush, and special castings (e.g., miniature figures, casket trim, belt buckles, trophies, and holloware)
Lead - Tin	Solders for sealing and joining metals (e.g., electronic applications including printed circuit boards) Automobile radiators High-temperature heat exchangers Terne-steel sheets for radio and television chassis, roofs, fuel tanks, air filters, oil filters, gaskets, metal furniture, gutters, and downspouts Coating of copper sheet used for building flashings Coating of steel and copper electronic components Electroplating
Lead - Calcium	Grids for large stationary stand-by power, submarine, and specialty sealed batteries Original equipment automotive batteries Negative grids for replacement batteries Electrowinning anodes Cable sheathing, sleeving for cable splices, specialty boat keels, and lead-alloy tapes

Table 4-3

Uses of Lead Alloys (Continued)

Alloy	Uses
Lead - Calcium - Aluminum	Negative battery grids
Lead - Calcium - Tin	Maintenance-free automotive battery grids Electrowinning anodes
Lead - Silver	Insoluble anodes for zinc and manganese electroplating Anodes in the d-c cathodic protection of steel pipe and structures used in fresh, brackish, or seawater Solder in high pressure, high temperature cooling systems Positive grids of lead-acid batteries Soft solders
Lead - Silver - Antimony	Production of thin copper foil for electronics
Lead - Silver - Calcium	Zinc electrowinning
Lead - Strontium - Tin	Maintenance-free battery grids Bearings
Lead - Tellurium	Used in pipes and sheets for chemical installations Shielding for nuclear reactors Cable sheathing
Fusible (lead, cadmium, bismuth, and tin in varying compositions)[a]	Fuses Low-melting sprinkler systems Foundry patterns Molds, dies, punches, chucks, cores, mandrels, flexible tubing, and low-temperature solder
Lead - Idium	Used to solder metals to glass
Lead - Lithium and Lead - Lithium - Tin	Battery grids Bearings

[a] Alloys that melt at very low temperatures (i.e., 32EF to 361.4EF [0EC to 183EC]).
Source: Reference 14

Table 4-4

Lead Compounds

Compound	Chemical Formula or Description	Uses
Lead acetate	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	Dyeing of textiles, waterproofing, varnishes, lead driers, chrome pigments, gold cyanidation process, insecticide, anti-fouling paints, analytical reagent, hair dye
Lead alkyl, mixed	A mixture containing various methyl and ethyl derivatives of tetraethyl lead and tetramethyl lead	Anti-knock agents in aviation gasoline
Lead antimonate	$Pb_3(SbO_4)_2$	Staining glass, crockery, and porcelain
Lead arsenate	$Pb_3(AsO_4)_2$	Insecticide, herbicide
Lead arsenite	$Pb(AsO_2)_2$	Insecticide
Lead azide	$Pb(N_3)_2$	Primary detonating compound for high explosives
Lead borate	$Pb(BO_2)_2 \cdot H_2O$	Varnish and paint drier, waterproofing paints, lead glass, electrically conductive ceramic coatings
Lead borosilicate	Composed of a mixture of the borate and silicate of lead	A constituent of optical glass
Lead carbonate, basic	$2PbCO_3 \cdot Pb(OH)_2$	Exterior paint pigments, ceramic glazes
Lead chloride	$PbCl_2$	Preparation of lead salts, lead chromate pigments, analytical reagent
Lead chromate	$PbCrO_4$	Pigment in industrial paints, rubber, plastics, ceramic coatings; organic analysis
Lead cyanide	$Pb(CN)_2$	Metallurgy
Lead dimethyldithiocarbamate	$Pb[SCSN(CH_3)_2]_2$	Vulcanization accelerator with litharge
Lead dioxide	PbO_2	Oxidizing agent, electrodes, lead-acid storage batteries, curing agent for polysulfide elastomers, textiles (mordant, discharge in dyeing with indigo), matches, explosives, analytical reagent.

Table 4-4 (Continued)

Lead Compounds

Compound	Chemical Formula or Description	Uses
Lead fluoborate	B_2F_8Pb	Salt for electroplating lead; can be mixed with stannous fluoborate to electroplate any composition of tin and lead as an alloy
Lead fluoride	PbF_2	Electronic and optical applications, starting materials for growing single-crystal solid-state lasers, high-temperature dry film lubricants in the form of ceramic-bonded coatings
Lead fluosilicate	$PbSiF_6 2H_2O$	Solution for electrorefining lead
Lead formate	$Pb(CHO_2)_2$	Reagent in analytical determinations
Lead hydroxide	$Pb(OH)_2$	Lead salts, lead dioxide
Lead iodide	PbI_2	Bronzing, printing, photography, cloud seeding
Lead linoleate	$Pb(C_{18}H_{31}O_2)_2$	Medicine, drier in paints and varnishes
Lead maleate, tribasic	$C_4H_6O_5Pb$	Vulcanizing agent for chlorosulfonated polyethylene. Highly basic stabilizer with high heat stability in vinyls
Lead molybdate	$PbMoO_4$	Analytical chemistry, pigments
Lead $-naphthalenesulfonate	$Pb(C_{10}H_7SO_3)_2$	Organic preparations
Lead naphthenate	$C_7H_{12}O_2xPb$	Paint and varnish drier, wood preservative, insecticide, catalyst for reaction between unsaturated fatty acids and sulfates in the presence of air, lube oil additive
Lead nitrate	$Pb(NO_3)_2$	Lead salts, mordant in dyeing and printing calico, matches, mordant for staining mother of pearl, oxidizer in the dye industry, sensitizer in photography, explosives, tanning, process engraving, and lithography
Lead oleate	$[CH_3(CH_2)_7CH:CH(CH_2)_7COO]_2Pb$	Varnishes, lacquers, paint drier, high-pressure lubricants
Lead oxide, red	Pb_3O_4	Storage batteries, glass, pottery, and enameling, varnish, purification of alcohol, packing pipe joints, metal-protective paints, fluxes and ceramic glazes.

Table 4-4 (Continued)

Lead Compounds

Compound	Chemical Formula or Description	Uses
Lead phosphate	$Pb_3(PO_4)_2$	Stabilizing agent in plastics
Lead phosphate, dibasic	$PbHPO_4$	Imparting heat resistance and pearlescence to polystyrene and casein plastics
Lead phosphite, dibasic	$2PbO·PbHPO_3·1/2H_2O$	Heat and light stabilizer for vinyl plastics and chlorinated paraffins. As a UV screening and antioxidizing stabilizer for vinyl and other chlorinated resins in paints and plastics
Lead phthalate, dibasic	$C_6H_4(COO)_2Pb·PbO$	Heat and light stabilizer for general vinyl use
Lead resinate	$Pb(C_{20}H_{29}O_2)_2$	Paint and varnish drier, textile waterproofing agent
Lead salicylate	$Pb(OOCC_6H_4OH)_2·H_2O$	Stabilizer or costabilizer for flooring and other vinyl compounds requiring good light stability
Lead sesquioxide	Pb_2O_3	Ceramics, ceramic cements, metallurgy, varnishes
Lead silicate	$PbSiO_3$	Ceramics, fireproofing fabrics
Lead silicate, basic	A pigment made up of an adherent surface layer of basic lead silicate and basic lead sulfate cemented to silica	Pigment in industrial paints
Lead silicochromate	A yellow lead-silicon pigment	Normal lead silicon chromate is used as a yellow prime pigment for traffic marking paints. Basic lead silicon chromate is used as a corrosive inhibitive pigment for metal protective coatings, primers, and finishers. Also for industrial enamels requiring a high gloss
Lead sodium thiosulfate	$PbS_2O_3·2Na_2S_2O_3$	Matches
Lead stannate	$PbSnO_3·2H_2O$	Additive in ceramic capacitors, pyrotechnics
Lead stearate	$Pb(C_{18}H_{35}O_2)_2$	Varnish and lacquer drier, high-pressure lubricants, lubricant in extrusion processes stabilizer for vinyl polymers, corrosion inhibitor for petroleum, component of greases, waxes, and paints
Lead subacetate	$2Pb(OH)_2Pb(C_2H_3O_2)_2$	Decolorizing agent (sugar solutions, etc.)
Lead suboxide	Pb_2O	In storage batteries

Table 4-4 (Continued)

Lead Compounds

Compound	Chemical Formula or Description	Uses
Lead sulfate	$PbSO_4$	Storage batteries, paint pigments
Lead sulfate, basic	$PbSO_4 \cdot PbO$	Paints, ceramics, pigments
Lead sulfate, blue basic	Composition: Lead sulfate (min) 45%, lead oxide (min) 30%, lead sulfide (max) 12%, lead sulfite (max) 5%, zinc oxide 5%, carbon and undetermined matter (max) 5%	Components of structural-metal priming coat paints, rust-inhibitor in paints, lubricants, vinyl plastics, and rubber products
Lead sulfate, tribasic	$3PbO \cdot PbSO_4 \cdot H_2O$	Electrical and other vinyl compounds requiring high heat stability
Lead sulfide	PbS	Ceramics, infrared radiation detector, semi-conductor, ceramic glaze, source of lead
Lead telluride	PbTe	Single crystals used as photoconductor and semiconductor in thermocouples
Lead tetraacetate	$Pb(CH_3COO)_4$	Oxidizing agent in organic synthesis, laboratory reagent
Lead thiocyanate	$Pb(SCN)_2$	Ingredient of priming mix for small-arms cartridges, safety matches, dyeing
Lead titanate	$PbTiO_3$	Industrial paint pigment
Lead tungstate	$PbWO_4$	Pigment
Lead vanadate	$Pv(VO_3)_2$	Preparation of other vanadium compounds, pigment
Lead zirconate titanate	$PbTiZrO_3$	Element in hi-fi sets and as a transducer for ultrasonic cleaners, ferroelectric materials in computer memory units
Litharge	PbO	Storage batteries, ceramic cements and fluxes, pottery and glazes, glass, chromium pigments, oil refining, varnishes, paints, enamels, assay of precious metal ores, manufacture of red lead, cement (with glycerol), acid-resisting compositions, match-head compositions, other lead compounds, rubber accelerator

Source: Reference 15

gasoline, these compounds are no longer produced in the United States, although they are imported for special applications such as use in aircraft fuel.

4.1.2 Lead Oxides

Lead oxide is a general term and includes lead monoxide or "litharge" (PbO); lead tetraoxide or "red lead" (Pb_3O_4); and black or "gray" oxide, which is a mixture of 70 percent lead monoxide and 30 percent metallic lead. Litharge is used primarily in the manufacture of various ceramic products. Because of its electrical and electronic properties, litharge is also used in capacitors and electrophotographic plates, as well as in ferromagnetic and ferroelectric materials. It is also used as an activator in rubber, a curing agent in elastomers, a sulfur removal agent in the production of thiols and in oil refining, and an oxidation catalyst in several organic chemical processes. It also has important markets in the production of many lead chemicals, dry colors, soaps (i.e., lead stearate), and driers for paint. Another important use of litharge is the production of lead salts, particularly those used as stabilizers for plastics, notably polyvinyl chloride materials (16).

Lead tetraoxide or red lead is a brilliant orange-red pigment. It is used as a pigment in anticorrosion paints for steel surfaces. It is also used in lead oxide pastes for tubular storage batteries, in ballistic modifiers for high-energy propellants, in ceramic glazes for porcelain, in lubricants for hot pressing metals, in radiation-shielding foam coatings in clinical x-ray exposure, and in rubber adhesives for roadway joints (14). Black lead is made for specific use in the manufacture of lead acid storage batteries (16).

Lead dioxide (PbO_2) is a brownish, black powder. Because of its strong oxidizing properties, it is used in the manufacture of dyes and to control burning in incendiary fires. It is also used as a curing agent for liquid polysulfide polymers and low molecular weight butyl and polyisopropane (17).

Lead titanate ($PbTiO_3$) and lead zirconate ($PbZrO_3$) are two lead oxides that are frequently mixed, resulting in highly desirable piezoelectric properties that are used in high-power acoustic radiating transducers, hydrophones, and specialty instruments (18).

4.1.3 Lead Sulfides

Lead sulfide (PbS) or galena is one of the most common lead minerals, appearing black and opaque. It is an efficient heat conductor and has semiconductor properties, making it desirable for use in photoelectric cells. Lead sulfide is used in ceramics, infrared radiation detectors, and ceramic glaze (18,19).

4.1.4 Lead Salts

Most lead salts are white or colorless and are used commercially as pigments. Basic lead carbonate ($Pb(OH)_2 \cdot 2PbCO_3$), basic lead sulfate ($Pb(SO_4) \cdot PbO$), and basic lead silicates ($3PbO \cdot SiO_2$) are well known white pigments. Basic lead carbonate is used as a component of ceramic glazes, as a curing agent with peroxides to form improved polyethylene wire insulation, as a color-changing component of temperature-sensitive inks, as a component of lubricating greases, and as a component of weighted nylon-reinforced fish nets made of polyvinylchloride (PVC) fibers (14).

Basic lead sulfate helps provide efficient, long-term, economic heat stability to flexible and rigid PVC. It can be dispersed easily, and has excellent electrical insulation properties. It is also an effective activator for azodicarbonamide blowing agents for vinyl foams (14).

Basic lead silicates are used by the glass, ceramic, paint, rubber, and plastics industries. Lead monosilicate ($3PbO \cdot 3SiO_2$) is used in formulating lead-bearing glazes for the ceramics industry and as a source of PbO in the glass industry. Lead bisilicate ($PbO \cdot O \cdot O_3Al_2O_3 \cdot 1.95SiO_2$) was developed as a low solubility source of lead in ceramic glazes for foodware. Tribasic lead silicate ($3PbO \cdot SiO_2$) is used primarily by glass and frit producers (14).

Lead chromates ($PbCrO_4$), colored salts, are used frequently as orange and yellow pigments (15).

Lead borates [$Pb(BO_2)_2H_2O$], germanates ($PbO•GeO_2$), and silicates ($PbO•SiO_2$) are glass-forming compounds that impart unique properties to glasses, enamels, glazes, and other ceramics. Other salts are used as stabilizers for plastics and rubbers, explosives, and in electroplating (14,15).

Section 4.2 Overview of Production and Use

Lead is produced in one of two ways: either by primary production through mining of ores or secondary production through recycling. According to the U.S. Bureau of Mines, the 1992 domestic production of recoverable lead from lead ores was 437,715 tons, or 22 percent of the total lead produced domestically. The 1992 quantity of domestic refined lead recovered from lead scrap was 1,008,257 tons, or 78 percent of the total lead produced domestically (20).

In 1992, domestic lead ore mining in the United States accounted for about 13 percent of the total world lead mine production for that year. Australia, Canada, China, and Kazakhstan (formerly part of the U.S.S.R.) accounted for nearly 47 percent of the world's lead mine production in 1992. Other major lead ore producing countries include Mexico, North Korea, Morocco, Peru, South Africa, Sweden, and other nations part of the former U.S.S.R. (20).

Most of the lead ore mined in the United States comes from the “lead-belt” in southeast Missouri. The recoverable lead mine production from Missouri was about 76 percent of the total lead mine production in the United States in 1992. In Missouri, lead is primarily recovered from lead, zinc, and lead-zinc ores. Lead is also mined in Alaska, Arizona, Colorado, Idaho, Illinois, Montana, New Mexico, New York, and Tennessee. In these states, lead is recovered from zinc, lead-zinc, copper, gold, and fluorspar ore deposits (20).

Lead ore is mined underground except when it is mined with copper ores, which are typically mined in open pits. The lead content of ores typically ranges from 3 to 8 percent, and the lead is usually in the form of a lead compound. The ores are processed at the mine site to produce a lead ore concentrate of 55 to 70 percent lead. Once dried, the lead-ore concentrates are shipped to primary lead smelter/refinery plants for further processing.

Lead ore concentrates are processed at primary lead smelter/refinery plants to produce lead metal or alloys. Primary lead smelting generally falls into SIC code 3339. Facilities with this primary SIC code must file EPCRA section 313 reports if applicable thresholds are exceeded. In 1992, primary lead smelter/refinery plants operating in the United States produced 335,270 tons of refined lead (20).

Lead is among the most recycled nonferrous metals in the world. Secondary production (from recycled materials) has risen steadily, such that in 1992, secondary output surpassed primary output in the United States by about a factor of three. This growth reflects the favorable economic conditions associated with lead recycling and the ability of lead to retain its physical and chemical properties when recycled (21).

Secondary lead smelters and refineries recover and refine metal from lead-bearing scrap materials and residues to produce lead and lead alloy ingots, lead oxide, and lead pigments. About 86 percent of recycled scrap was from lead-acid battery plates (20). Secondary lead smelting and refining generally falls into SIC code 3341. Facilities with this primary SIC code must file EPCRA section 313 reports if applicable thresholds are exceeded.

In 1992, 1,330,228 tons of lead were consumed by product manufacturing sectors in the United States. Figure 4-1 shows the various manufacturing sectors consuming lead in 1992 (20).

As shown in Figure 4-1, the manufacture of storage batteries (SIC code 3691) is the major end use of lead (accounting for 81 percent of domestic lead use). About 63 percent of the total storage battery consumption is for manufacturing battery posts and grids, and 37 percent was for manufacturing

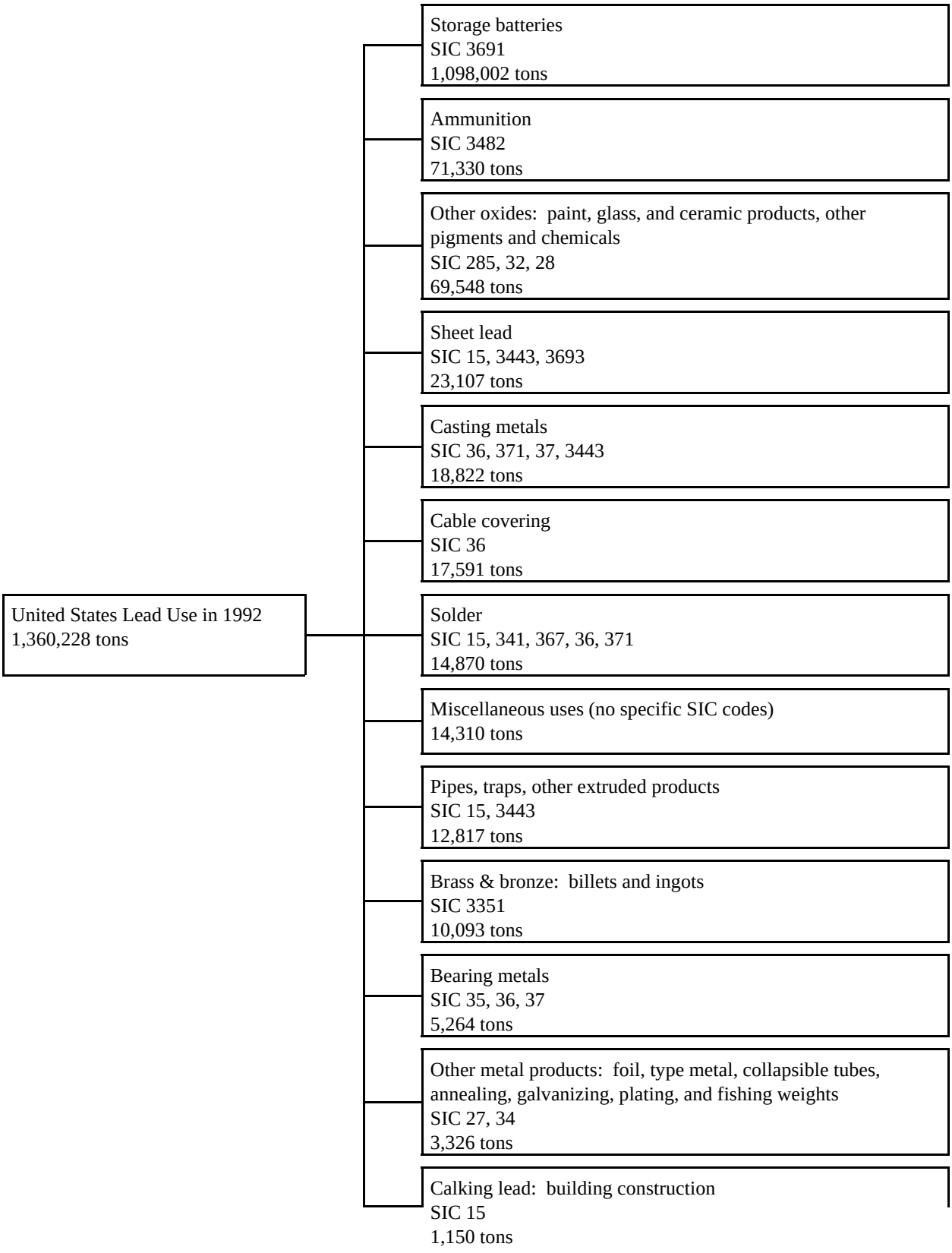

Figure 4-1. Usage of Lead in the United States in 1992

Source: Reference 20.

lead oxides used in battery paste (20). The manufacture of ammunition and "other oxides" (SIC code 3482) are the next largest uses of lead, each accounting for 5 percent of the total domestic lead consumption in 1992. "Other oxides" include the manufacture of pigments and chemicals, paints, glass, and ceramic products (various SIC codes; see Figure 4-1). The manufacture of pigments and chemicals account for 16 percent, and the manufacture of paints and glass and ceramics account for 84 percent of the total lead consumption for the "other oxides" category (20).

The manufacture of casting materials, solder, sheet metal, and cable covering (various SIC codes; see Figure 4-1) each accounted for 1 to 2 percent of total lead consumption in 1992 (20).

Some uses of lead experiencing increased growth over the past few years with continued growth expected are the use of lead in cathode ray tubes for television and computer screens (to protect viewer and service technicians from harmful radiation), and use of lead solder in the microelectronics industry (21).

Tables 4-5 and 4-6 provide summaries of the facilities filing EPCRA section 313 reports for lead and lead compounds, respectively, in reporting year 1998. These tables provide an indication of the type and number of facilities in various SIC codes that were required to report for lead and lead compounds at the threshold quantities of 25,000/10,000 pounds. As a result of the lead rule, EPA expects many new facilities in industries listed in Tables 4-5 and 4-6 and several new industries (not already listed in Tables 4-5 and 4-6) to comply with the new 100 pound reporting threshold for lead and lead compounds. Table 4-7 shows those industries for which EPA expects to receive additional EPCRA section 313 reports as a result of the lead rule.

Table 4-5

Summary of TRI Reporting For Lead, 1998

SIC Code and Name	Number of Facilities	Number of Form R Reports	Number of Form A Reports	Section 8.1 Releases (pounds)	Total Section 8 Quantities (pounds)	Total Section 8 Quantities, Excluding Recycling (pounds)
No SIC reported	2	2	0	39,509	53,017	39,509
10 - Metal Mining	9	8	1	444,949	446,049	444,949
12 - Coal Mining	4	0	4	--	--	--
22 - Textile Mill Products	1	1	0	0	0	0
24 - Lumber and wood products except furniture	2	1	1	3,367	3,367	3,367
25 - Furniture and fixtures	4	3	1	9,536	65,485	19,072
26 - Paper and allied products	1	1	0	--	10,334	--
28 - Chemicals and allied products	15	11	4	9,901	125,785	14,945
29 Petroleum refining and related industries	14	10	4	2,833	3,155	2,976
30 Rubber and misc plastic products	20	18	2	17,570	814,707	36,302
32 - Stone, clay, glass, and concrete products	25	23	2	67,141	6,289,243	431,669
33 - Primary metals industries	253	228	25	6,432,432	245,245,857	8,562,985
34 - Fabricated metal products, except machinery and transportation equipment	203	180	23	1,080,911	16,991,833	1,144,434
35 - Industrial and commercial machinery and computer equipment	49	42	7	5,608	802,658	10,456
36 Electronic and other electrical equipment and components, except computer equipment	96	86	10	366,858	13,610,170	428,622
37 - Transportation equipment	78	64	15	1,050,608	8,246,915	1,059,367
38 - Measuring and analyzing instruments	13	12	1	12,706	340,276	12,719
39 - Miscellaneous manufacturing industries	11	6	5	24,275	92,232	29,882
4911 - Electric services	16	14	2	367,473	367,473	367,473
4931 - Electric and other services	1	1	0	14,876	14,876	14,876
4953 - Refuse systems	23	23	0	12,645,894	14,067,649	14,036,625
5169 - Chemicals and allied products, n.e.c	4	1	3	70	70	70
5171 - Bulk petroleum	4	3	1	414	828	414
7389 - Solvent recovery services	1	1	0	0	52,364	52,364
87 - Engineering, accounting, research, management, and related services	2	2	0	21,190	322,825	31,358
92 - Justice, public order, and safety	2	2	0	98,697	144,319	103,402
97 - National security and international affairs	2	2	0	26,121	85,121	26,121
Invalis SIC code	1	1	0	--	1	--
Total	856	746	111	22,742,939	308,196,609	26,873,957

Source: Toxic Release Inventory (References 1, 22)

Table 4-6

Summary of TRI Reporting For Lead Compounds, 1998

SIC Code and Name	Number of Facilities	Number of Form R Reports	Number of Form A Reports	Section 8.1 Releases (pounds)	Total Section 8 Quantities (pounds)	Total Section 8 Quantities, Excluding Recycling (pounds)
No SIC reported	1	1	0	10	9,314	10
10 - Metal Mining	40	39	1	208,175,220	208,924,887	208,187,912
12 - Coal Mining	3	3	0	299,000	299,000	299,000
22 - Textile Mill Products	6	6	0	11,907	44,149	13,578
24 - Lumber and wood products except furniture	2	2	0	60	20,414	60
25 - Furniture and fixtures	3	3	0	50,300	50,300	50,300
26 - Paper and allied products	1	1	0	59	39,740	59
28 - Chemicals and allied products	136	105	31	593,389	6,180,703	2,421,039
29 Petroleum refining and related industries	27	22	5	93,736	103,972	102,879
30 Rubber and misc plastic products	87	68	19	93,817	583,578	123,553
32 - Stone, clay, glass, and concrete products	56	54	2	3,528,509	93,818,384	3,703,890
33 - Primary metals industries	259	246	16	45,873,698	306,450,807	46,582,979
34 - Fabricated metal products, except machinery and transportation equipment	48	44	4	117,340	2,196,410	148,675
35 - Industrial and commercial machinery and computer equipment	12	11	1	23,302	627,679	23,683
36 Electronic and other electrical equipment and components, except computer equipment	131	130	1	1,771,229	351,105,737	1,964,758
37 - Transportation equipment	46	42	4	103,186	2,119,311	130,018
38 - Measuring and analyzing instruments	4	4	0	315	83,227	388
39 - Miscellaneous manufacturing industries	3	3	0	540	52,543	1,144
4911 - Electric services	156	155	2	7,969,935	8,065,179	8,060,772
4931 - Electric and other services	1	1	0	21,000	21,000	21,000
4953 - Refuse systems	37	37	0	20,663,756	37,774,431	29,243,640
5169 - Chemicals and allied products, n.e.c	2	1	1	NR	NR	NR
5171 - Bulk petroleum	1	1	0	0	0	0
7389 - Solvent recovery services	1	1	0	113,050	113,050	113,050
87 - Engineering, accounting, research, management, and related services	1	1	0	23	23	23
97 - National security and international affairs	2	2	0	887	39,030	39,030
Invalid SIC code	2	2	0	98,726	101,113	98,731
Total	1,068	985	87	289,602,994	1,018,823,981	301,330,171

NR = none reported.
Source: Toxic Release Inventory (References 1, 22)

Table 4-7

Industries Expected to Increase The Number of EPCRA Section 313 Reports Filed For Lead and Lead Compounds for Reporting Year 2001 and Beyond

SIC Code	Industry	SIC Code	Industry
20 - 39	Coal-, oil-, and wood-fired industrial sources	3334	Primary production of aluminum
1021	Copper ores	3341	Secondary smelting of nonferrous metals
1031	Lead and zinc ores	3351	Copper rolling and drawing (brass and bronze)
1041	Gold ores	3353	Aluminum sheet plate and foil
12	Coal mining	3354	Aluminun extruded products
2047	Dog and cat food	3363	Aluminum die-casting
2048	Prepared feeds, n.e.c.	3365	Aluminum foundries
2611	Pulp mills	3471	Electroplating, plating, polishing, anodizing, and coloring
2816	Inorganic pigments	3479	Galvanizing (part of SIC 3471, metal coating, engraving and allied services)
28197	Inorganic potassium and sodium compounds, n.e.c.	3482	Small arms ammunition
2821	Plastics materials, synthetic resins, and nonvulcanizable elastomers	3671	Electron tubes
2873	Nitrogeneous fertilizers, except organics	3672	Printed circuit boards
28733	Organic fertilizers	3674	Semiconductors and related devices
2874	Phosphatic fertilizers	3675	Electronic capacitors
2875	Fertilizers, mixing only	3676	Electronic resistors
2911	Petroleum refining	3677	Electronic coils and transformers
3229	Pressed and blown glassware, n.e.c.	3678	Electronic connectors
3231821	Stained glass	3679	Electronic components, n.e.c.
3241	Cement, hydraulic	3691	Storage battery manufacturing
3261	Vitreous plumbing fixtures	371	Motor vehicles and motor vehicle equipment
3312	Blast furnaces and steel mills	39312	Organ manufacturing
3313	Electrometallurgical products (ferroalloys)	4911	Electric services (coal and oil facilities only)
3315	Steel wiredrawing and steel nails and spikes	4931	Electric and other services (coal and oil facilities only)
3321	Gray/ductile iron foundries	4939	Combination utilities (coal and oil facilities only)
3322	Malleable iron foundries	4953	Refuse systems
3324	Steel investment foundries	5171	Bulk petroleum
3325	Steel foundries, n.e.c.	7389	Solvent recovery services

Source: Reference 1

Section 4.3 Lead in Raw Materials

Raw materials processed by a wide variety of facilities may contain metallic lead or lead compounds. Lead is present as a trace constituent in many metal ores, including lead, zinc, copper, gold, silver, and molybdenum ores. Lead is also a trace constituent in coal, oil, or wood that is

processed or otherwise used by many facilities. Because lead is present as a trace constituent in crude oil, it can also be found in many products derived from oil such as some heating oils and gasolines. Table 4-8 lists some common concentrations of lead in these raw materials and the corresponding quantity needed to exceed the 100 pound threshold. Note that lead concentrations in metal ores vary from mine to mine and in oil-based products by the source of the crude oil and the specific manufacturer of the products. For purposes of TRI reporting, the lead concentration in the raw materials used at a particular site should be used in threshold and release and other waste management calculations where available rather than the common lead concentrations shown in Table 4-8.

Table 4-8

Typical Concentration of Lead In Raw Materials and Quantity Required to Meet the Reporting Threshold

Raw Material	Concentration Lead (ppmw)	Reference[1]	Quantity Needed to Meet the 100 lb Lead Threshold
Copper ores	11,000	1	9,090 lbs
Lead and zinc ores	24,000	1	4,170 lbs
Gold ores	6.6	1	1.52×10^7 lbs
Coal (avg)	111	2	9.01×10^5 lbs
Anthracite coal	7	2	1.43×10^7 lbs
Bituminous coal	14	2	7.14×10^6 lbs
Subbituminous coal	6	2	1.67×10^7 lbs
Lignite coal	7	2	1.43×10^7 lbs
Wood	20	2	5.00×10^6 lbs
Crude oil	0.31	1	3.23×10^8 lbs
No. 2 fuel oil[2]	0.50	1	2.82×10^7 gallons[3]
No. 6 fuel oil[2]	1.0	1	1.27×10^7 gallons[3]
Gasoline	0.079	1	1.27×10^9 lbs
Aviation gas	1,750	1	5.71×10^4 lbs
JP-4	<3	23	$>3.33 \times 10^7$ lbs
Natural gas	<0.05 mg/m^3	24	$>9.08 \times 10^8$ m^3

[1]Numbers correspond to the references listed in Section 6.0.
[2]Constituents are most likely metal compounds rather than elemental lead. Lead is listed in this table because concentration data are for only the metal occurring in the fuel. Concentrations for metal compounds would be somewhat higher depending on the metal compound.
[3]Assumes the following densities: No. 2 Fuel Oil - 7.1 lb/gallon; No. 6 Fuel Oil - 7.9 lb/gallon.

Facilities should use the best readily available information that is applicable to their operations. In the absence of site-specific information, EPA recommends that you contact your supplier or an applicable trade association to determine whether lead concentration data is available for the type of ore or fuel you use.

Coal and oil are common fuel sources at many facilities covered under EPCRA section 313, and are used especially for electric power generation. Section 4.5 discusses combustion of lead-containing fuels in more detail. Oil feedstocks (including No. 2 fuel oil, and No. 6 fuel oil) are processed through carbon black production facilities and petroleum bulk stations and terminals.

Section 4.4 Recovery, Recycle, and Reuse of Lead and Lead Compounds

The manufacture and subsequent processing of lead may result from a facility's lead recovery activities. A facility may recover lead from batteries, dismantled equipment, or from scrap and industrial wastes using a thermal or chemical extractive process. Major sources of recycled or recovered lead include scrap batteries and wastes and sludges from electrolytic refining plants. Secondary smelting operations recover lead for reuse or sale. For EPCRA section 313 reporting, it is important to remember that the process of melting metals releases metals to the environment and that EPA has not yet promulgated regulations defining waste management activities such as recycling. The following paragraphs provide some guidance on these topics.

Melting of a metal can cause it to be released into the environment. When in a molten state the most common forms in which the metal can be released are vapors and particulates from handling and heating raw materials, and refining operations. Lead and lead compounds may be present in the raw material and may be found in fumes and dust from the heating and refining operations. EPA does not have a regulatory definition of a fume or a dust, but considers dusts, for the purposes of reporting, to consist of solid particles generated by any mechanical processing of materials including crushing, grinding, rapid impact, handling, detonation, and decrepitation of organic and inorganic materials such as rock, ore, and metal. Dusts do not tend to flocculate except under electrostatic forces. A fume is an

airborne dispersion consisting of small solid particles created by condensation from the gaseous state, in distinction to a gas or vapor. Fume arises from the heating of solids. The condensation is often accompanied by a chemical reaction, such as oxidation. Fumes flocculate and coalesce. [Question and Answer Number 302 in Reference 8 goes into more detail about fumes and vapors.]

Pursuant to the Pollution Prevention Act (PPA) of 1990, facilities must report the quantities of toxic chemicals released, treated for destruction, combusted for energy recovery and recycled. EPA has not yet promulgated regulations defining these waste management activities. EPA considers toxic chemicals "recycled" when the toxic chemicals are recovered for reuse. If toxic chemicals are directly reused, without any intervening reclamation or recovery steps, the toxic chemicals are not considered recycled for Form R reporting purposes. Reclamation or recovery would not include simple phase changing of the toxic chemical before further reuse (e.g., simple remelting of scrap metal). A reclamation and recovery step, however, would include changing the relative amounts of the chemicals in an alloy. A recovery step would include removing toxic chemicals from a pollution control device or removing contaminants from the toxic chemical after it has been used and can no longer be used for its intended purpose. Accordingly, if the scrap metal is not mixed with other scrap and can be remelted and directly reused, without any recovery steps, then the toxic chemicals in the scrap metal are being directly reused. Facilities should use their best readily available information in determining if the scrap sent off-site is being directly reused or instead is recycled because of an intervening reclamation or recovery step prior to reuse.

Section 4.5 Combustion of Fuels Containing Lead

All EPCRA section 313 chemicals contained in fuels combusted for energy production are considered otherwise used. The amount of lead and lead compounds present in the fuel (e.g., coal, fuel oil) should be included in the otherwise use threshold. Additionally, during combustion processes it is expected that lead is converted to various lead compounds. EPA considers this to be "coincidental manufacture" of lead compounds. Therefore, the amount of lead compounds generated from fuel combustion must also be applied to the manufacturing threshold (40 CFR 372.3). Current information

indicates that lead and lead compounds found in coal convert to PbO_2 (a low molecular weight combustion product containing lead) during combustion (*Study of Hazardous Air Pollutant Emissions from Electricity Generating Units - Final Report to Congress*, February 1998). If you do not know the lead compound present in the fuel, EPA recommends you assume it is lead dioxide (PbO_2), for threshold calculations. Recall that lead and lead compounds are separately listed substances, and threshold calculations should be made for them separately. For fuels other than coal, EPA recommends using the same assumption that lead and lead compounds are converted to PbO_2 during combustion. The lead compounds formed during combustion are considered manufactured for threshold purposes (40 CFR 372.3). Unless facilities have information to indicate otherwise, EPA recommends they assume that they manufacture PbO_2 during combustion, and that 100% of the lead portion of the lead or lead compounds in the fuel are converted to PbO_2.

SECTION 5.0 RELEASE AND OTHER WASTE MANAGEMENT CALCULATIONS

The release and other waste management calculations provided in this section demonstrate some available techniques you can use to calculate your facility's releases and other waste management quantities of lead and metal portions of lead compounds. You should determine the best information available for your operation and decide which calculation method works best for you.

Section 5.1 Lead and Lead Compound Air Emissions

In lieu of actual test data, the use of process-specific air emission factors is the most common way to estimate the amount of lead released to air. If your process uses an air pollution control device, you can use its capture and control efficiency to determine the quantity of point source emissions. Depending on the type of device, the controlled lead air emissions may become part of a wastewater stream (e.g., lead collected in scrubber wastewater) or baghouse dust. Sources of air emission factors include U.S. EPA's Compilation of Air Emission Factors, AP-42 (25) and Factor Information Retrieval (FIRE) Data System (26), the California Air Resources Board's Air Toxics Database (27), and chemical- and industry-specific factors determined by trade associations, and other factors published in the literature.

One example of industry-specific air emission factors determined by a trade association can be found in the *Ferrous Foundry Air Emissions Study - Final Report* (28). This report describes the development of an industry-specific database that can be downloaded from the Internet to assist facilities in estimating air emissions of Hazardous Air Pollutants, many of which are reportable as EPCRA section 313 chemicals or chemical categories. As always for TRI reporting, if you have other means of estimating air emissions that are more applicable to your operations, they should be used in place of generally-available air emission factors.

In May 1998, the U.S. EPA Office of Air Quality Planning and Standards published *Locating and Estimating Air Emissions From Lead and Lead Compounds* (EPA-454/R-98-006) (2). This

document (referred to as the L&E document below) described the properties of lead and lead compounds as air pollutants, defined their production and use patterns, identified source categories of air emissions, and provided lead emission factors. The remainder of this section provides a brief summary about lead emissions as described in the L&E document. Facilities that must report lead emissions under the TRI program are encouraged to use the L&E document. All emission factors discussed in the L&E document are also contained in U.S. EPA's FIRE Data System (26). To prepare this TRI guidance document, the FIRE Data System was searched and all emission factors for lead and lead compounds were extracted; these emission factors are shown in Appendix C.

Appendix C also contains the lead and lead compound emission factors contained in the California Air Resources Board's Air Toxics Database (27). This source, and U.S. EPA's FIRE Data System, contain many emission factors for lead and lead compounds. Other U.S. EPA sources of emission factors with which the reader may be familiar, such as the Compilation of Air Emission Factors, AP-42 (25), are included in U.S. EPA's FIRE Data System. Note that EPA periodically updates AP-42 and the FIRE Data System as new data become available. You should reference EPA's Internet site for the Clearinghouse for Inventories and Emission Factors (CHIEF) for updates to these documents and development of new source materials.

The following example shows how to calculate lead air emissions using an emission factor.

Example - Point Source Emission Estimate Using an Emission Factor

Your facility uses 100 million gallons of No. 6 fuel oil to generate electricity during the reporting year. You have determined that you exceed the 100 pound reporting threshold for lead and must calculate all releases and other waste management activity amounts.

After evaluating your options, you decide to use a FIRE Data System emission factor for your calculation for uncontrolled emissions from a boiler (0.00151 lb lead/1,000 gal No. 6 fuel oil).

Amount of lead air emissions:

100,000,000 gal No. 6 fuel oil/yr × (0.00151 lb lead emitted/1,000 gal No. 6 fuel oil) = 151 lb lead emitted/yr

If you do not have any controls on the boiler, you should report this amount in Part II, Sections 5.2 (Stack or Point Air Emissions) and 8.1 (Quantity Released) of the 2001 Form R. If you have emissions controls on your boiler, the amount controlled (if known) should be subtracted from this amount and reported as appropriate depending on the ultimate disposition of the collected waste material.

Fuel combustion activities and other heated processes that process or otherwise use lead can generate lead emissions. Emissions of lead originate from lead compounds contained in fuels and emitted during combustion. The lead contained in fuels must be applied toward threshold calculations, and any emissions of lead resulting from combustion of fuels must be included in the release report. Because metals such as lead only change forms (chemical and physical states) during combustion and are never destroyed, the amount of lead in the original fuel or waste will be equal to the amount of lead found in the ash or emitted in the effluent gas. The type of air emissions control device(s) used at your facility may govern the final destination of the controlled lead (e.g., dust in a baghouse or part of scrubber wastewater). Table 5-1 presents typical sources of lead emissions (2).

Table 5-1

Sources of Lead Emissions

Facility/Process Type	Operation Sources of Lead Emissions
Primary and secondary lead smelting	All unit operations
Primary and secondary copper production	Most heated and ore-handling unit operations
Primary zinc smelting	Sintering
Secondary aluminum operations	All unit operations
Coke production	Coal preparation and handling, Fugitive emissions from oven
Iron and steel foundries	Most heated and casting unit operations
Ore mining, crushing, and grinding	Drilling, blasting, loading, conveying, screening, unloading, crushing, and grinding operations
Brass and bronze processing	Most heated unit operations
Combustion of coal, natural gas, oil, or wood	Boiler exhaust gas and bottom and fly ash handling
Municipal waste, industrial, sewage sludge, medical waste, and hazardous waste incinerators	Exhaust stack and bottom and fly ash handling
Other forms of incineration: drum and barrel reclamation, scrap tire incineration and open burning of scrap tires, and crematories	Exhaust stack and bottom and fly ash handling
Pulp and paper industry	Chemical recovery unit operations
Portland cement manufacturing	Raw material handling and kiln exhaust gases
Pressed and blown glass	Raw material blending and transport, melting, and forming and finishing
Lead-acid battery production	Grid casting, lead reclamation, slitting, small parts casting, and three-process operation
Lead oxides in pigments	Exhaust gas
Lead cable coating	Melting kettle
Frit manufacturing	Frit smelting operation
Ceramics and glazes	Glaze firing and spraying phases
Miscellaneous lead products: ammunition, type metal, bearing metals, pipe and sheet lead, and abrasive grain manufacturers	Heated unit operations and dust-handling operations
Solder manufacturing	Lead melting and solder paste production
Electroplating (including printed circuit boards)	Plating process
Stabilizers in resins	Materials (powder) handling
Asphalt concrete	Drying process
Application of paints	Spraying, brushing, dipping, blending, drying, curing
Shooting ranges and explosive ordnance disposal sites	Firing of small arms ammunition with lead projectiles and/or lead primers
Rubber products	Material handling
Fuel production	While being phased out, some fuels still contain lead

Source: U.S. EPA. *Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds*. EPA-454/R-98-006. Office of Air Quality Planning and Standards (OAQPS). May 1998.

U.S. EPA's FIRE Data System (26) includes emission factors for fuel oil and wood combustion. Lead emissions from distillate fuel oil combustion can be calculated using an emission factor of 8.9 lb/10^{12} BTU (uncontrolled). The average lead emission factor from No. 6 fuel oil combustion is 0.00151 lb/1,000 gal (uncontrolled). Lead emission factors for wood combustion operations include 0.0029 lb/ton (uncontrolled), 0.00032 lb/ton (using a mechanical collector as the control device), 0.00035 lb/ton (using a wet scrubber as the control device), and 0.000016 lb/ton (using an electrostatic precipitator as the control device). After determining the quantity of lead released to the air, facilities must also determine the quantity of lead in the bottom ash and collected by the control device (see Section 5.3 for an example).

A mass balance calculation using the total amount of lead in the fuel may be used to determine these quantities if you do not have site-specific data. The release or waste management of the lead in bottom ash or from the control device (e.g., effluent from a wet scrubber) must be reported on the Form R. The following example shows how you can use Table 4-8 and Appendix C to estimate lead emissions from coal combustion.

Lead emissions may also be calculated using monitoring data. For instance, your facility might continuously monitor stack emissions, or data might be available from short-term testing performed at the facility. Engineering calculations, for example Raoult's law, may also be used for calculations. Mass balances are not typically used to calculate emissions, but can be used if all other quantities (e.g., lead leaving with the product, released with wastewater, disposed with solid waste) are known, as demonstrated in the following example.

Example - Fugitive Emission Estimate Using a Mass Balance

Your facility manufactures a lead-containing product. Based on purchase and import records, the amount of lead brought on site totals 200,000 pounds per year. The amount of lead leaving with the product is calculated to be 198,500 pounds per year.

Your facility wastewater from washdowns, tank cleanings, and scrubber operations is discharged to a POTW. You monitor the wastewater to comply with the POTW pretreatment permit. The concentration of lead in the water is 34 mg/L. The volume of water discharged to the POTW during the reporting year is 250,000 gallons.

The amount of lead discharged to the POTW is calculated below:

(34 mg/L lead) × (250,000 gal water) × (3.785 L/gal) × (1 lb/453,592 mg) = 71 lb lead

This quantity should be reported in Part II, Section 6.1 (Discharges to POTWs) and Section 8.1 (Quantity released) of the 2001 Form R.

No solid waste sources of lead were identified at your facility, therefore, you assume the remaining quantity of lead is released as fugitive emissions. The lead fugitive emissions are calculated using the following mass balance:

$[200{,}000\ \text{lb}]_{in} = [198{,}500\ \text{lb} + 71\ \text{lb} + \text{fugitive emissions lb}]_{out}$

Fugitive lead emissions = [200,000-198,500-71] lbs = 1,429 lb/yr

This quantity should be reported in Part II, Section 5.1 (Fugitive or non-point air emissions) and Section 8.1 (Quantity released) of the 2001 Form R.

Section 5.2 Lead in Wastewater

Wastewater sources of lead include process wastewater, and area washdowns and tank clean outs from processes in which lead or lead compounds are manufactured, processed, or otherwise used. If a wet air pollution control device (e.g., scrubber) is used in a process generating lead emissions, lead can be transferred from the air stream to the water stream. This wastewater may be treated on site, discharged to surface water or a POTW, or transferred off site for other waste management activities. In addition to the sources listed above, spills and one-time events may also generate a lead-containing wastewater stream.

If your facility discharges to surface water, you most likely have a NPDES or state discharge permit. This permit may require you to monitor for lead. You can use this information to calculate the

amount of lead discharged to surface water. Discharges to POTWs may also require lead monitoring. Table 5-2 shows the industries required to monitor their effluents for lead due to EPA effluent limitations guidelines for lead (29). Monitoring data that are collected to comply with permits or effluent limitations guidelines may be useful for estimating water discharges. Alternatively, if you have not conducted monitoring but a regulatory limit for lead discharges exists, it may be appropriate to use the regulatory limit as a reasonable "worst-case" to estimate your yearly discharge of lead.

Table 5-2

Industries With Effluent Limitations For Lead

The Regulations Are Described at 40 CFR Part	Point Source Category
415	Inorganic Chemicals Manufacturing
420	Iron and Steel
421	Non-Ferrous Metals Manufacturing
426	Glass Manufacturing
428	Rubber Manufacturing
437	Centralized Waste Treatment
438	Metal Products and Machinery (proposed regulations)
440	Ore Mining and Dressing
442	Transportation Equipment Cleaning
444	Waste Combustors
461	Battery Manufacturing
464	Metal Molding and Casting
466	Porcelain Enameling
468	Copper Forming
471	Non-Ferrous Metals Forming and Metal Powders

The example below shows an approach to calculating lead discharges using monitoring information.

Example - Lead Discharged to a POTW Using Monitoring Information

Your facility exceeds a lead reporting threshold. Additionally, you are required to perform monitoring for wastewater that is discharged to your local POTW for certain chemicals, including lead, two times each year. The results of the monitoring were:

April 4: 2 ppm lead (representative of the 6-month period for January through June)
October 5: 2.4 ppm lead (representative of the 6-month period for July through December)

For the reporting year, the following water volumes were discharged to the POTW:

January through March: 425,000 gal
April through June: 555,000 gal
July through September: 345,000 gal
October through December: 390,000 gal

First, convert the water flows to pounds, using the standard density for water of 8.345 lb/gal:

425,000 gal × (8.345 lb/gal) = 3,550,000 lb for January through March
555,000 gal × (8.345 lb/gal) = 4,630,000 lb for April through June
345,000 gal × (8.345 lb/gal) = 2,880,000 lb for July through September
390,000 gal × (8.345 lb/gal) = 3,250,000 lb for October through December

Using the appropriate lead concentrations measured during the monitoring periods, the amount of lead discharged to the POTW is:

$$[(2 \text{ lb lead} / 1\times 10^6 \text{ lb water}) \times (3{,}550{,}000 + 4{,}630{,}000) \text{ lb water}]_{\text{Jan - June}} +$$

$$[(2.4 \text{ lb lead} / 1 \times 10^6 \text{ lb water}) \times (2{,}880{,}000 + 3{,}250{,}000) \text{ lb water}]_{\text{Jul - Dec}}$$

$$= 31 \text{ lb/yr lead}$$

This quantity should be reported in Part II, Section 6.1 (Discharge to POTW) and included in Part II, Section 8.1 (Quantity Released) of the 2001 Form R.

Mass balances and engineering calculations can also be used to determine the amount of lead in the wastewater. If your facility treats wastewater on site, you may need to perform engineering calculations to determine how much lead becomes part of the waste sludge and how much is discharged. In this case, Part II, Section 7 (on-site treatment, energy recovery, and recycling) of the 2001 Form R should be completed as appropriate.

Section 5.3 Lead Solid Waste Calculations

Solid wastes that contain lead and lead compounds include dust or solid raw materials spilled during transfer or process operations. Lead contained in a solution, such as petroleum products, may also be splashed or spilled on the ground and, after evaporation or if cleaned with absorbent materials, this may result in solid waste generation. Other solid waste sources include sludge from on-site treatment, spent bags or filters from air pollution control devices, and ash from combustion operations. Solid material spills and ash may also contribute to fugitive emissions of particulate matter. The amount of lead in solids is commonly calculated using mass balances from records (such as spill reports and hazardous waste manifests). Monitoring data on sludge may be available, but as mentioned in the previous wastewater section, engineering calculations can be performed to determine the lead content in the sludge.

Facility-specific information, such as waste analyses and process knowledge, can be used to estimate amounts of lead in combustion wastes. In the absence of site-specific data, facilities can use default values for concentrations of lead in ash, presented in Table 5-3.

Table 5-3

Lead Concentration in Combustion Residuals

Combustion Residual	Concentration (ppm)	Reference[1]
Coal Fly Ash	2,120	30
Coal Bottom Ash	1,082	30
Oil Ash	100,000	30

[1]Number corresponds to the references listed in Section 6.0.

If your facility produces lead-containing wastes, you can use a mass balance to determine the quantity of lead released or otherwise managed as waste. Using facility concentrations, or literature concentrations if facility-specific concentrations are not available, you can determine the quantity of lead processed at your facility from the amount in the raw material. From process and engineering

knowledge, the destination of the lead releases and other waste management activity quantities can be determined.

The mass balance approach can also be applied to a combustion process where, after determining the quantity of lead released to the air, facilities must also determine the quantity of lead in the bottom ash and collected by the control device. A mass balance calculation using the total amount of lead in the fuel may be used to determine these quantities if you do not have site-specific data. The release or waste management of lead in bottom ash or from the control device (e.g., effluent from a wet scrubber) must be reported on the Form R. The following example shows how you can use Table 4-8 and Appendix C to estimate lead emissions from coal combustion.

Example - Lead Release and Other Waste Management Calculations from Coal Combustion

Your facility combusts lignite coal in a boiler with a Source Classification Code #10300305, and you have installed an electrostatic precipitator as the air pollution control device for this boiler. You fed 0.5 million tons of lignite coal into the boiler during the reporting year and collected 1.0 million pounds of bottom ash for disposal. The task is to determine if a threshold has been exceeded and to estimate the reportable amounts of lead for the applicable sections of the Form R. Assuming you do not have site-specific test data, it may be appropriate to use default values from Table 4-8 to determine the amount of lead in the coal and Table 5-3 to estimate the amount of lead in the bottom ash, and an emission factor from Appendix C to estimate air releases.

Threshold Determination:
First, you must determine if you exceed a threshold for lead or lead compounds. Any TRI chemical or chemical compounds that are present in fuel are considered to be otherwise used. Table 4-8 lists the average lead concentration in lignite coal as 7 ppm. Therefore:

$$(0.5 \times 10^6 \text{ tons coal}) \times (2{,}000 \text{ lb/ton}) \times (7 \text{ lb lead}/ 1 \times 10^6 \text{ lb coal}) = 7{,}000 \text{ lb lead}$$

This is the amount of elemental lead in the coal. The mass of lead in the coal exceeds 100 lbs; therefore, your facility exceeds the otherwise use reporting threshold for lead and you must file a Form R.

Stack Air Release:
EPA's FIRE system contains an emission factor for lead from combustion of lignite coal in a boiler with SCC #10300305 and an ESP (Appendix C): 4.2×10^{-4} pounds of lead are emitted per ton lignite coal burned.

$$(0.5 \times 10^6 \text{ tons coal}) \times (4.2 \times 10^{-4} \text{ lb of lead/ton coal}) = 210 \text{ lb lead}$$

This quantity should be reported in Part II, Section 5.2 (Stack or Point Air Emissions) and included in Section 8.1 (Quantity Released) of the 2001 Form R.

Quantities Otherwise Managed As Waste:
The lead that is not emitted is either collected in the ESP, or contained in bottom ash. You should estimate the amount of lead to each of these waste streams and report the quantities in the applicable sections of Form R. Potentially, you may collect these wastes for on-site recycle (Part II Sections 7C and 8.4), or you may transfer them off site (in which case Part II, Section 6.2 and applicable sections of Part II, Section 8 should be completed). Additionally, since the flue gases have been sent through an on-site air pollution control system, Sections 7A and 8.6 (Quantity Treated On-Site) should be completed as appropriate.

Based on the default concentration listed in Table 5-3 (1,082 ppm), the quantity of lead in the bottom ash is:

$$(1.0 \times 10^6 \text{ lb bottom ash}) \times (1{,}082 \text{ lb lead}/1 \times 10^6 \text{ pound bottom ash}) = 1{,}082 \text{ lb lead}$$

A mass balance around the boiler can now be used to estimate the amount of lead collected in the ESP:

(lead in coal) = (lead released to air) + (lead in bottom ash) + (lead in control devices)

(7,000 lb lead in coal) - (210 lb to air) - (1,082 lb in bottom ash) = 5,708 lb lead is ESP dust

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